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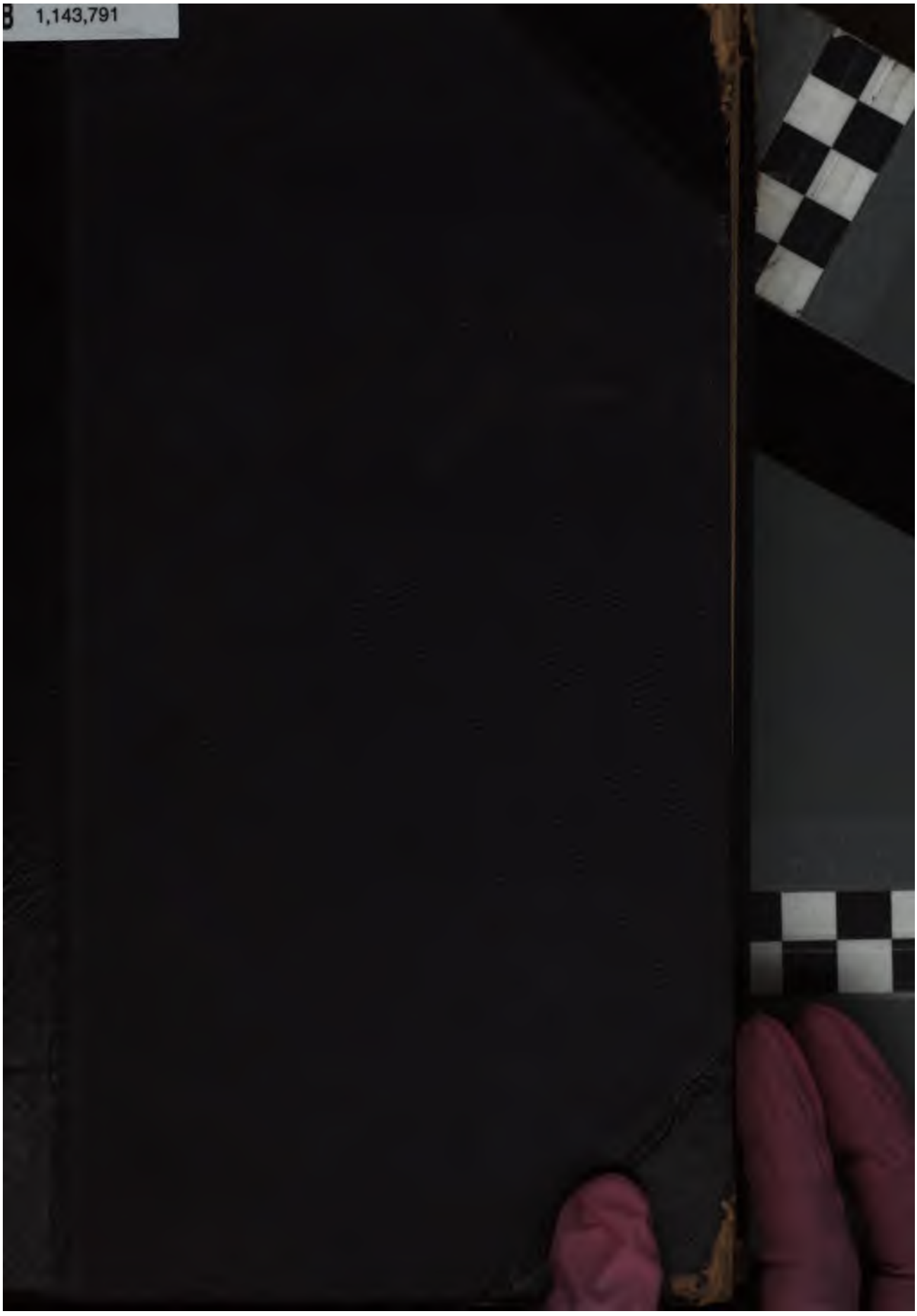

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OF

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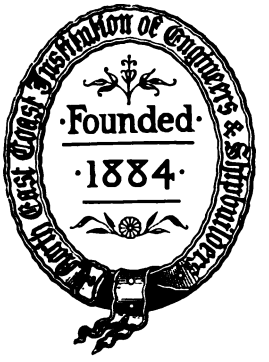


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VOLUME XVIII.

EIGHTEENTH SESSION, 1901-1902.

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*Modern Copper Smelting.* By E. D. Peters, junr. 1901.
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*Illustrated Official Journal of Patents*, Patent Office, London, E.C.
Institution of Civil Engineers, 25, Great George Street, Westminster, London, S.W.
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Allan, George J., 20, Villa Place, Newcastle-upon-Tyne ... ... (E) Nov. 1898
Allardes, Wm., c/o Messrs. Harland & Wolff, Ltd., Engine Works, Belfast ... ... ... ... ... ... ... ... (E) Nov. 1884
Anderson, Charles William, Mandale House, Mandale Road, Thornaby-on-Tees ... ... ... ... ... ... (S) Nov. 1900
Anderson, Joseph, 5, Westfield Terrace, Wallsend-on-Tyne ... (E) Nov. 1884
Anderson, Thos. James, Cotton Exchange Building, Galveston, Texas, United States of America ... ... ... (E SUR) Mar. 1898
Andrew, D., 33, Osborne Road, Jesmond, Newcastle-upon-Tyne ... (SUR) Jan. 1885
Andrews, Edward W., 12, Thornhill Terrace, Sunderland ... ... (E E) Dec. 1901
Andrews, Jas., Eton Villa. Cathcart, Glasgow ... ... ... (E) Nov. 1884
Angus, W. J., Messrs. Vickers, Sons & Maxim, Naval Construction Works, Barrow-in-Furness ... ... ... ... ... (E) Oct. 1892
Angus, John Chas., c/o Messrs. Robt. Stephenson & Co., Ltd., Hebburn ... ... ... ... ... ... ... ... (E) Nov. 1899
Armstrong, Adam Latimer, Portugal House, Clytha Park, Newport, Monmouthshire ... ... ... ... ... ... ... ... (S) April 1901
Armstrong, Joseph, 4, Salem Avenue, Sunderland ... ... ... (S) Nov. 1892
Armstrong, Robert B., c/o Messrs. Day, Summers & Co., Northam Ironworks, Southampton ... ... ... ... ... (E) Oct. 1887
Armstrong, Walter, 14, Elwin Terrace, Sunderland... ... ... (S) May 1899
Ascroft, Frederick W., 11 Park Street, Lytham ... ... .. (E) May 1900
Atherton, William Henry, M.Sc., 2, Holly Lea, Lime Avenue, Urmston, Manchester ... ... ... ... ... ... (E) Oct. 1891
Atkinson, Alfred, 12, Pape Buildings, Newcastle-upon-Tyne ... (E) May 1901
Atkinson, F. C., 37, Croydon Road, Newcastle-upon-Tyne... ... (E) Dec. 1892
Atkinson, George H., 3, Acclom Street, Hartlepool ... ... ... (E) Nov. 1898
Atkinson, John Joseph, 7, Swiss Road, Elm Park, Fairfield, Liverpool ... ... ... ... ... ... ... ... (E) Mar. 1891

B.

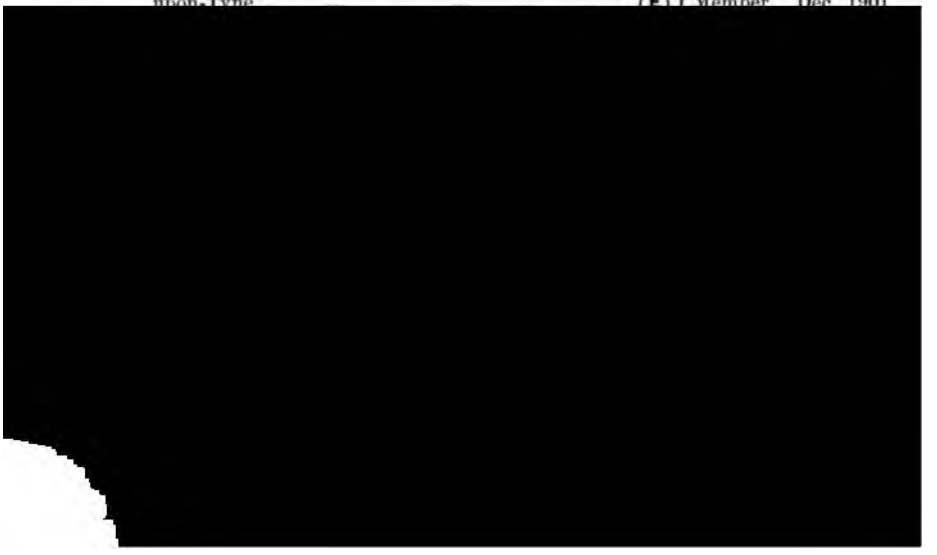
Baber, Samuel Ernest, 9, Montross Avenue, Redland, Bristol ... (E) Nov. 1901
Baggallay, Robert, Messrs. Flannery, Baggallay & Johnson, 9, Fenchurch Street, London, E.C. ... ... ... ... (C E) May 1902

ELECTED.

Barclay, James, Lloyd's Register of Shipping, Swansea ... ...(SUR) Nov. 1888
Barley, C. J., c/o Messrs. The London Electric Supply Corporation, Stowage Wharf, Deptford, London, S.E. ...(E) { Graduate, Feb. 1885 / Member, Dec. 1886
Barnett, James Rennie, Westfield, Crookston, Renfrewshire, N.B. (S) Oct. 1889
Barrett, A., Dalton House, West Hartlepool ... ... ... (E) May 1896
Barron, T. G., Hobourne, Elswick Road, West Hartlepool ... (E) Oct. 1888
Bateman, John, Vane Terrace, Darlington ... ... ... ... (E) Mar. 1901
Batey, John Thomas, 52, Queen's Road, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (S) Nov. 1885
Batliboi, Jehangir Framji, 71, Apollo Street, Fort, Bombay ... (E) Dec. 1888
Baxter, J., 26, Simonside Terrace, Heaton, Newcastle-upon-Tyne (E) Nov. 1884
Beadon, D. C., "Stoneham," Beech Grove Road, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... (E) Jan. 1885
Beckett, Frank, 8, Woodbine Place, Coatsworth Road, Gateshead-on-Tyne ... ... ... ... ... ... ... ... (E E) Dec. 1901
Bell, Geo. Arthur, 48, Crown Street, Newcastle-upon-Tyne (E) { Graduate, Oct. 1890 / Member, Jan. 1894
Bell, Joshua Robson, 40, Hill Street, Jarrow-on-Tyne ... ... (S) Mar. 1899
Bell, William, Messrs. Cleland's Slipway Co., Willington Quay-on-Tyne ... ... ... ... ... ... ... ... (E) Nov. 1888
Bennett, Percy M., c/o Mexican Gas Co., Calla, Santa Clara No. 7. Mexico City ... ... ... ... ... ... ... (E E) Dec. 1899
Berkley, A. B., 11, Croft Terrace, Jarrow-on-Tyne ... ... (E) Mar. 1887
Berven, Ferdinandt, c/o Messrs. Bergens Mekaniske Vœrksted, Bergen, Norway ... ... ... ... ... ... ... (S) April 1901
Bigge, D. L. Selby, 27, Mosley Street, Newcastle-upon-Tyne ... (E E) Nov. 1894
Billetop, Torben Christian, 3, Guildford Place, Heaton, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Nov. 1896
Bindeaböll, S. C. W., Aktieselskabet Helsingors Jernskibs- og Maskinbyggeri Helsingor, Denmark ... ... ... ... (S) Nov. 1884
Binns, Aubrey B., 23, Thornhill Terrace, Sunderland ...(E) { Graduate, Oct. 1894 / Member, Dec. 1899
Black, J., 1, Church Street, West Hartlepool ... ... ... (E) Nov. 1888
Black, Wm., 1, Lovaine Place, Newcastle-upon-Tyne ... ... (E) Jan. 1885
Blackett, Walter, c/o Messrs. Hawthorn, Leslie & Co., St. Peter's Works, Newcastle-upon-Tyne ... (E) { Graduate, Nov. 1886 / Member, Nov. 1892
Blackie, Thomas Reid, Lloyd's Register of Shipping, 71, Fenchurch Street, London ... ... ... ... ... (SUR) Nov. 1890
Bladon, Jas. Buckley, 12, Havelock Street, Newcastle-upon-Tyne (E) Nov. 1901
Blake, James, Northbrook, Linthorpe, Middlesbro' ... ... (E) Nov. 1899
Blaylock, Robert, 10, Greenbank Crescent, Darlington ... ... (F M) Dec. 1900
Blenkinsop, John N., Marine Supt. Engineer, Great-Eastern Railway, Parkeston Quay ... ... ... ... ... ... (E) Oct. 1885
Blomberg, Carl A., 2262, North 19th Street, Philadelphia, Pa., United States of America ... ... ... ... ... (E) Oct. 1896
Blow, Charles, Beech Grove, Benton, Newcastle-upon-Tyne ... (E) Nov. 1898
Blumer, Wm., Ashbrooke Tower, Sunderland ... ... ... (S) Dec. 1886
Böcler, Harry, 19, Azalea Terrace South, Sunderland (S) { Graduate, Mar. 1898 / Member, Dec. 1901
Boddy, John, 96, Dock Street, Newport, Monmouthshire ... ... (E) Dec. 1888
Bodin, Lauritz M., 58, John Street, Sunderland ... ... (E & SUR) Dec. 1889

ELECTED.

Bone, W. J., 61, Linskill Terrace, North Shields ... ... ... (S) Dec. 1884
Bonnyman, James Smith, 64, Plasturton Avenue, Cardiff... ... (E) Nov. 1889
Boolds, Jas. H., c/o Messrs. Vickers, Sons, & Maxim, Naval Construction Works, Barrow-in-Furness ... ... ... ... (S) Oct. 1886
Booth, Edward Spence, Box 5124, Boston, U.S. America ...(M S & N A) Oct. 1889
Booth, John William, Union Foundry, Rodley, near Leeds ... (E) April 1892
Borrie, Peter, 4, Oxford Terrace, Stockton-on-Tees ... ... ... (E) Nov. 1900
Borrowman, William Cameron, Wh.Sch., Newstead, Grange Road, West Hartlepool ... ... ... ... ... ... ... (E) Oct. 1896
Bosi, Guiseppe, Presso Rastelli, Sampierdarena, Genoa, Italy (E & NA) Jan. 1894
Bowden, John, Sheriff Mount, Gateshead-on-Tyne (E) { Graduate, Jan. 1894 / Member, Oct. 1898
Boyd, Arthur, Lloyd's Register of Shipping, Bute Docks, Cardiff(E SUR) May 1895
Boyd, Wm., North House, Long Benton, Newcastle-upon-Tyne ... (E) Nov. 1884
Boyt, John T., 387, Bourse Buildings, Philadelphia, Pa., U.S.A. ... (E) Nov. 1893
Bramwell, Balfour, 43, Stranmills Road, Belfast ... (E) { Graduate, Nov. 1886 / Member, Nov. 1887
Brankston, R. T., 36, Hawthorn Street, Newcastle-upon-Tyne ... (E) Nov. 1884
Brew, George, c/o Messrs. Furness, Withy & Co., steamship owners, Montreal ... ... ... ... ... ... (SUR & C E) May 1896
Brigham, Robert F., 5, Argyle Terrace, South Shields ... ... (E) Mar. 1897
Broadbent, Frank, c/o 5, Bond Court, Wallbrook, London, E.C. ... (E E) Nov. 1893
Brock, Henry W., c/o Messrs. Wm. Denny & Bros., Dumbarton (E & S) Nov. 1899
Brockett, Charles, 35, Milton Road, West Hartlepool ... ... (E) Feb. 1899
Brotherston, James, 23, Nelson Street, Sunderland ... ... (E) Oct. 1895
Brown, Eugene, c/o Messrs. J. H. Holmes & Co., Portland Road, Newcastle-upon-Tyne ... ... ... ... ... ... (E E) Feb. 1886
Brown, Geo. Matthew, c/o Messrs. The British Thompson-Houston Co., Rugby ... ... ... ... (E) { Graduate, April 1895 / Member, Nov. 1897
Brown, James, c/o Messrs. Palmer's Shipbuilding Co., Jarrow-on-Tyne ... ... ... ... ... ... ... ... (E) Mar. 1891
Brown, Percy J., Salem Cottage, Sunderland ... ... ... (E) May 1899
Brown, Robson, 32, Salmon Street, South Shields ... ... ... (E) Nov. 1889
Brown, T. R., 37, Stansfield Street, Sunderland ... (E) { Graduate, May 1885 / Member, Oct. 1886
Brown, William, c/o Messrs. Siemens Brothers & Co., Woolwich... (E) April 1887
Browne, Benjamin C., jun., 58, Brighton Grove, Newcastle-upon-Tyne (E) { Graduate, Oct. 1898 / Member, Dec. 1901



ELECTED.

Burbidge, Alfred H., Backwell Rectory, Bristol ... (E) { Graduate, Oct. 1895 / Member, Oct. 1898

Burley, M. F., 14, Croft Terrace, Jarrow-on-Tyne ... ... (F) Nov. 1899

Burnett, Norman, C, Lombard Street, Newcastle-upon-Tyne ... (E) Oct. 1891

Bushell, Chas. A., 1, Benton Terrace, Newcastle-upon-Tyne (N A & SUR) Nov. 1893

Butterfield, George, 4, Kayll Road, Sunderland ... ... ... (S) Nov. 1884

Butterworth, George Herbert, 41, Brook Road, Bootle, nr. Liverpool (E) Nov. 1899

Buchan-Sydserff, Thos. ... ... ... ... ... ... ... (E) Oct. 1888

Byers, Wm. Lumsden, 11, Norfolk Street, Sunderland ... ... (E) May 1900

C.

Cairns, C. W., M. Sc., c/o Miss Brown, 31, Cheltenham Street, New Barns, Barrow-in-Furness ... ... ... (E) { Graduate, Nov. 1894 / Member, Dec. 1897

Carr, Ralph, jun., 19, Abingdon Street, Westminster, London, S.W. ... ... ... ... ... (E) { Graduate, Jan. 1894 / Member, Nov. 1901

Carr, Wilson Story, 13, Mosley Street Newcastle-upon-Tyne ... (C E) May 1900

Cama, Nusserwanji Bomanji, Sleater Road, Tardeo, Bombay, British India ... ... ... ... ... ... ... (E) Dec. 1888

Cameron, Angus, c/o Messrs. Sir James Laing & Sons, Deptford Yard, Sunderland ... ... ... ... ... ... (S) Nov. 1892

Campbell, J. Jennings, Bureau Veritas Register of Shipping, 155, Fenchurch Street, London, E.C. ... ... ... ... (E) Oct. 1888

Campbell, John M., 57, Osborne Road, Jesmond, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... (N A) April 1895

Campbell, Thomas, 129, Bute Road, Docks, Cardiff ... ... (S) Mar. 1894

Canning, Chas. E., 29, Duan Terrace, Ryton-on-Tyne (S) { Graduate, Dec. 1897 / Member, Nov. 1899

Cannell, Frank, Messrs. H. Parry & Son, Lisbon ... ... (E & S) Nov. 1887

Carnegie, Alfred Q., 21, Eldon Place, Newcastle-upon-Tyne ... ... ... ... ... ... (EE) { Graduate, Nov. 1899 / Member, Dec. 1901

Carney, J. H., Glengariffe, Stow Park, Newport, Monmouth ... (E) Mar. 1897

Carstons, Samuel, Messrs. Burmeister & Wains, Maskin-og Skibsbyggeri, Copenhagen, Denmark... ... ... ... ... (S) Dec. 1887

Carter, Geo. J., c/o Messrs. Sir W. G. Armstrong, Whitworth & Co., Elswick Shipyard, Newcastle-upon-Tyne ... ... ... (N A) Dec. 1897

Casey, James, 10, Philpot Lane, London, E.C. ... ... ... (E) Nov. 1891

Ceuvel, John L., 763, Gulgenstug, Naarden, Holland ... ... (E) Mar. 1886

Chambers, John, 114, Sidney Grove, Newcastle-upon-Tyne ... (E) Dec. 1897

Chapman, Harry Reynolds, Messrs. Clarke, Chapman & Co., Gateshead-on-Tyne ... ... ... ... ... ... (E) Mar. 1893

Charlton, Henry, 1, Millfield Terrace, Gateshead-on-Tyne ... (E) Nov. 1884

Charlton, T., 25, Lincoln Street, Gateshead-on-Tyne ... ... (E) Nov. 1884

Chaston, Edward Catmore, 36, St. George's Terrace, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Oct. 1894

Cherry, Thos. Wm. Fry, c/o Messrs. Tyne General Ferry Co., St. Peter's, Newcastle-upon-Tyne ... ... ... ... (E) Oct. 1894

Chicken, Christopher B., 169, Hampstead Road, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Dec. 1901

Chicken, Thomas, c/o Messrs. Newport Engineering and Ship Repairing Co., Newport, Monmouth ... ... ... ... (E) Oct. 1892

Chilton, Joseph, 73 Theresa Street, Blaydon-on-Tyne ... ... (E) Dec. 1899

ELECTED.

Chisholm. Alexander, c/o Messrs. Wigham Richardson & Co., Neptune Works, Walker-on-Tyne ... ... ... ... (S) Mar. 1893
Christie, C. J. D., Neptune Works. Walker-on-Tyne ... ... (S) Nov. 1884
Christie, J. D., Woodside, Tynemouth ... ... ... ... (S) Nov. 1884
Christie, Reginald, Woodside, Tynemouth ... ... ... ... (E E) Mar. 1900
Christie, David M., 95, Great Western Road, Glasgow ... ... (E) Mar. 1900
Clark, Charles, c/o Messrs. Robert Irvine & Co., Tower Chambers, West Hartlepool ... ... ... ... ... ... ... (E) Jan. 1897
Clark, George, Southwick Engine Works, Sunderland ... (E) Feb. 1888
Clark, Henry, Southwick Engine Works, Sunderland ... ... (E) Oct. 1887
Clarke, Harry, Lloyd's Register of Shipping, Bank Chambers, Newport, Monmouth ... ... ... ... ... ... (E) Mar. 1897
Clarke, Henry Trevisa, Deptford Shipyard, Deptford, Sunderland (S) Mar. 1892
Clarke, William Henry, 21, The Terrace, Roker, Sunderland ... (E) Dec. 1896
Clark, John Harwood, Messrs. Sir James Laing & Sons, Deptford Yard, Sunderland ... ... ... ... ... ... ... (E) Nov. 1901
Cleghorn, Alexander, 10, Whittinghame Drive, Kelvinside, Glasgow (E) Feb. 1897
Coates, Matthew C., 26, Denmark Street, Gateshead-on-Tyne ... (E) Nov. 1897
Cohn, William M., 2, Marine Terrace, North Shields ... ... (S) Nov. 1893
Coleby, James W., Churchill Street, Willington Quay-on-Tyne ... ... ... ... ... ... ... (E) { Graduate, Oct. 1891 / Member, Jan. 1894
Common, John B. A., Lloyd's Register of Shipping, 71, Fenchurch Street, London, E.C. ... ... ... ... ... ... (E) April 1896
Coninck, Gastin de, 2, Summerhill East, Sunderland ... ... (S) April 1902
Conradi, Carl, Prinsens Gade 2b, Christiania, Norway ... ... (E) Nov. 1884
Consiglio, Luigi, 8, Via Paterno, Palermo ... ... ... ... (N A) Nov. 1890
Cookson, John A., 4, Durham Terrace, Gateshead-on-Tyne ... ... ... ... ... ... (E) { Graduate, Dec. 1895 / Member, Nov. 1897
Cookson, William D., Milton House, Albert Drive, Low Fell, Gateshead-on-Tyne ... ... ... ... ... ... ... (E) Nov. 1901
Cooper, Burjorjee S. N., Sea View, Mahim, Bombay, British India (E) May 1900
Coote, Arthur, Messrs. R. & W. Hawthorn, Leslie, & Co., Hebburn-on-Tyne ... ... ... ... ... ... ... ... (S) Nov. 1884
Cornish, H. P., Lloyd's Register of Shipping, 28, Kattendyk, Ouest Quai, Antwerp ... ... ... ... ... ... (E) Oct. 1888
Couche, Henry Drew, c/o Messrs. Laird Bros., Birkenhead Works, Birkenhead ... ... ... ... ... ... ... (S) Oct. 1891

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ELECTED.

Crookston, John, 72, Mark Lane, London, S.E. ... ... ... (E) Mar. 1896
Cruddas, W. D., Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., Elswick, Newcastle-upon-Tyne ... ... ... (E) Dec. 1884
Cruickshank, Alexander, H.M. Naval Dockyard, Gibraltar ...(SUR) Mar. 1892
Cumming, William, c/o Mr. Hyslop, Hampton House, Grey Street, St. Kilda, Melbourne, Australia ... ... ... ... ... (E) Mar. 1896
Cummins, W. R., 15, Western Elms Avenue, Reading, Berkshire (E) Nov. 1884

D.

Dale, John, 13, Ewesley Road, Chester Road, Sunderland ... (E) Mar. 1897
Dalrymple, Alexander, 25, Rutland Avenue, Sefton Park, Liverpool (E) Nov. 1901
Dalrymple, Wm., Myrtle Cottage, nr. Cleadon, Sunderland ... (E) Dec. 1886
Dalrymple, William, Jun., 42, Cleveland Road, Sunderland ... (E) Dec. 1895
Danielsen, John William, Highfield, Farquhar Road, Birmingham... ... ... ... ... ... ... ... (E) { Graduate, Mar. 1899 / Member, Mar. 1902
Darling, W. J., Lloyd's Register of Shipping, Dock Chambers, Barry ... ... ... ... ... ... ... ... ... (S) April 1887
Darney, John, c/o Messrs. Short Bros., Pallion, Sunderland ... (S) Nov. 1884
Davidson, Alexander, 15, North View, Heaton, Newcastle-upon-Tyne (E) Nov. 1900
Dawson, Thomas Charles, c/o Messrs. Baird Bros., Bull Ring Engine Works, North Shields ... ... ... ... ... (E) May 1902
Deighton, William, Messrs. Deighton's Patent Flue Co., Vulcan Works, Pepper Road, Leeds ... ... ... ... ... (E) Nov. 1897
Denny, Archibald, c/o Messrs. Wm. Denny & Bros., Dumbarton ... (S) Dec. 1891
Denny, Leslie, c/o Messrs. Wm. Denny & Bros., Dumbarton ... (S) Nov. 1899
Denny, Peter, Bellfield, Dumbarton... ... ... ... (E & S) Nov. 1899
De Rusett, Edwin W., Warden House, Percy Park Road, Tynemouth ... ... ... ... ... ... ... ... ... (S) Nov. 1890
Detchon, John, 115, Bell Terrace, Newcastle-upon-Tyne ... ... (E) Feb. 1899
Dick, F. W., c/o Messrs. Park Gate Iron and Steel Co., Ltd., Park Gate, Rotherham ... ... ... ... ... (I & S M) Oct. 1891
Dickie, James, Falstone House, West Park. South Shields ... (S) Nov. 1901
Dickie, James, 428, Mississippi Street, Potrero, San Francisco, California, U.S.A.... ... ... ... ... ... ... ... (S) Mar. 1894
Dickie, John P., Falstone House, West Park, South Shields ... ... ... ... ... ... (E) { Graduate, Mar. 1898 / Member, May 1900
Dickinson, F. T., 23, Park Place W., Sunderland ... (E) { Graduate, May 1885 / Member, Oct. 1886
Dickinson, James C., The Cloisters, Sunderland ... ... ... (E) Nov. 1884
Dickinson, John, Park House, Sunderland ... ... ... ... (E) Nov. 1884
Dickinson, W., The Club, Sunderland ... ... ... ... (E) Nov. 1884
Dietze, F. G., Messrs. The Hamburg South American Steam Ship Company, Hamburg ... ... ... ... ... ... (E) Nov. 1893
Dippie, Joseph Robt., 130 Albert Road, Jarrow-on-Tyne ... ... (S) April 1900
Dixon, Harold Raylton, Messrs. Sir Raylton Dixon & Co., Ltd., Shipbuilders, Middlesbrough ... ... ... ... ... (S) May 1902
Dixon, James, c/o Messrs. Ropner & Sons, Shipbuilders, Stockton-on-Tees ... ... ... ... ... ... ... ... (E) Dec. 1893
Dixon, John Rochester, 4, St. Nicholas's Buildings, W., Newcastle-upon-Tyne ... ... ... ... (E) { Graduate, Oct. 1887 / Member, Feb. 1893
Dixon, John Thomas, 27, Meldon Terrace, Heaton, Newcastle-upon-Tyne ... ... ... ... ... (E) { Graduate, Dec. 1899 / Member, Dec. 1901

| | | ELECTED. |
|---|---|---|
| Dixon, William John, R.N., H.M.S. "Pactolus," Channel Squadron ... ... ... ... ... ... (E) | Graduate, | Mar. 1896 |
| | Member, | Nov. 1899 |
| Dobson, Henry James, c/o Messrs. William Dobson & Co., Newcastle-upon-Tyne ... ... ... ... (S) | Graduate, | Oct. 1891 |
| | Member, | Feb. 1898 |
| Dobson, Wm. G., The Chesters, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... (S) | Graduate, | Feb. 1896 |
| | Member. | Dec. 1901 |
| Dobson, William, Shipbuilder, Walker-on-Tyne ... ... ... (S) | | Nov. 1888 |
| Donald, James, 58, General Gordon Terrace, Sunderland ... ... (S) | | Nov. 1884 |
| Donkin, George, St. Andrew's Engine Works, Newcastle-upon-Tyne (E) | | Oct. 1892 |
| Donovan, J. W., 5, Ash Place, Newcastle Road, Sunderland ... (E) | | April 1885 |
| Dos Santos, Apolinaris J., Rua Coronel, Sampaio 59, Rio Grande-do-Sul, Brazil ... ... ... ... ... ... ...(SUR) | | Nov. 1891 |
| Douglas, John F., c/o Messrs. Ramage & Ferguson, Leith... ... (E) | | Jan. 1888 |
| Douglas, William Y., Messrs. Douglas Bros., Globe Iron Works, Blaydon-on-Tyne ... ... ... ... ... ... ... (E) | | Dec. 1901 |
| Dove, Herbert J., 25, Ashfield Terrace W., Newcastle-upon-Tyne (E) | | Nov. 1896 |
| Downing, Nicholas, Glenbrooke, Victoria Avenue, Norton Road, Stockton-on-Tees ... ... ... ... ... ... ... (I F) | | Oct. 1894 |
| Dowsen, Chas., 21, Croft Terrace, Jarrow-on-Tyne... ... ... (E) | | Dec. 1885 |
| Doxford, Albert Ernest, M.A., 1, Grange Crescent, Sunderland... ... ... ... ... ... ... ... (E) | Graduate, | Oct. 1890 |
| | Member, | Nov. 1893 |
| Doxford, Charles D., Pallion Shipyard, Sunderland ... ... (S) | | Nov. 1884 |
| Doxford, Robt., jun., Silksworth Hall, Sunderland (S) | Graduate, | Feb. 1897 |
| | Member, | Dec. 1901 |
| Doxford, Robert P., Pallion Engine Works, Sunderland ... ... (E) | | Nov. 1884 |
| Doxford, Sir, W. Theodore, M.P., Pallion Shipyard, Sunderland... (S) | | Nov. 1884 |
| Dressler, Gustav, 21, Fischmarkt, Altrona-on-Elbe ... ... ... (E) | | Jan. 1900 |
| Duckitt, Jno., Leazes Gate Villa, Newcastle-upon-Tyne ... ... (E) | | Nov. 1884 |
| Duckitt, John Brentnall, 179, Great Norbury Street, Hyde, Cheshire ... ... ... ... ... ... (E E) | Graduate, | Oct. 1888 |
| | Member, | April 1895 |
| Duckitt, Talbot, Hawthorndale Cottage, Paton Street, Alloa, N.B. ... ... ... ... ... ... (E E) | Graduate, | Oct. 1891 |
| | Member, | Oct. 1898 |
| Dudgeon, F. S., 30, Great St. Helens, London, E.C. ... ... (E) | | Feb. 1885 |
| Dugdale, William H., Wear Dock Yard, Sunderland ... ... (S) | | Mar. 1894 |
| Duguid, Robert, c/o Messrs. Harland & Wolff, Drawing Office Department, Belfast ... ... ... ... ... ... (S) | | Oct. 1892 |
| Dunlop, John, c/o Messrs. Scott & Co., Shipbuilders, Dockyard, Greenock ... ... ... ... ... .. ... ... (S) | | Mar. 1898 |

ELECTED.

Eeles, Robert, Queen Street, Newcastle-upon-Tyne ... ... (E) April 1889
Elder, Edward, c/o Messrs. Frew, Elder, & Co., 9 Queen Street, Newcastle-upon-Tyne ... ... ... (S) { Graduate, Nov. 1890 / Member, Oct. 1892
Elliott, William D., Hessle, Hull ... ... ... ... ... (E) Nov. 1894
Eltringham, Harry, Messrs. J. T. Eltringham & Co., Stone Quay, South Shields ... ... ... ... ... ... ... (S) Feb. 1901
Eshelby, William, 13, Brankingham Terrace, Norton Road, Stockton-on-Tees ... ... ... ... ... ... ... (E) Feb. 1888
Evans, Lewis, West India House, 96 and 98, Leadenhall Street, London, E.C. ... ... ... ... ... ... ...(SUR) Dec. 1890
Evans, William, Superintendent Engineer, Rosedene, Whitchurch, Cardiff ... ... ... ... ... ... ... ... (E) Nov. 1889
Eyres, Reginald J., 4, Cedars Crescent, Sunderland ... (C E) Feb. 1900

F

Fairbairn, Archbold, Violet Street, South Hylton, Sunderland ... (E) Mar. 1902
Fairbairn, James, 2, Creswick Road, Bow, London, E. (E) { Graduate, May 1885 / Member, April 1895
Farina, A. J., 63, Quayside, Newcastle-upon-Tyne ... ... (E) Nov. 1884
Farminer, A. E., c/o Messrs. Lloyd's Register of Shipping, 3, St. Nicholas' Buildings, Newcastle-upon-Tyne ... ... (SUR) Jan. 1900
Farquharson, Geo. James, c/o Messrs. Elder, Dempster & Co., Luisenhof, Neue Gröninger Strass, 1, Hamburg ... ... (E) April 1899
Fenwick, James, B.Sc., C.E., 19, Bridge Street, Sydney, New South Wales ... ... ... ... ... ... ... ... (E) Oct. 1892
Ferguson, Wm. Deeble, Iveagh Chambers, Belfast ... ... ... (CE) Feb. 1901
Ferrier, Robert M., B.Sc., University College, Bristol ... ... (E) Nov. 1892
Fettes, James, c/o Messrs. R. E. Mudie & Sons, Marine Buildings East, Dock Street, Dundee ... ... ... ... ... (E) May 1899
Field, Arthur M. C., 7, Mayfield Road, Gosforth, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E E) Jan. 1898
Figari, Emanuel D., c/o Messrs. Barwick & Wright, 100, Bishopsgate Street, London, E.C. ... ... ... ... ... (S) Dec. 1900
Finch, Herbert K., Greyside, St. Edmund's Road, Ipswich ... ... ... ... ... ... (E) { Graduate, Dec. 1888 / Member, Nov. 1894
Findlay, John Taylor, Lloyds Register, 3, St. Nicholas Buildings, Newcastle-upon-Tyne ... ... ... ... ... (S SUR) Mar. 1902
Fish, Thomas Wilson, Lloyd's Register of Shipping, Calcutta, British India ... ... ... ... ... ... ...(SUR) May 1892
Fitzgerald, Durham W., Messrs. J. T. Eltringham & Co., Stone Quay, South Shields ... .. ... ... ... ... (S) Dec. 1900
Fletcher, Robert, Walker Forge, Walker-on-Tyne ... ... ...(F M) Dec. 1886
Flohr, Justus, Director der Stettiner Maschinenbau-Actien-Gesellschaft "Vulcan," Rantstrasse 9, Stettin ... ... ... (E) Oct. 1886
Foley, Wm. C. le B., 3008, West Avenue, Newport News, Virginia, U.S.A. ... ... ... ... ... (S) { Graduate, Nov. 1887 / Member, Oct. 1892
Ford, John McLaren, 70, Mount Pleasant, Barrow-in-Furness ... (S) Nov. 1896
Forrest, Frank, 2, Bath Terrace, Tynemouth ... ... ... (E E) Nov. 1901
Foster, Henry, c/o Messrs. Patent Shaft and Axletree Co., Ltd., Wednesbury ... ... ... ... ... ... ... (E) April 1885
Foster, L. P., 113, Park Road, Newcastle-upon-Tyne (E) { Graduate, Nov. 1893 / Member, Oct. 1898

ELECTED.

Foster, Martin, Claremont, Norton, Stockton-on-Tees ... ... (F M) Nov. 1900
Fothergill, J. R., 1, Bathgate Terrace, West Hartlepool ... ... (C E) Mar. 1886
Fowler, Jas. Speir, 27, Whitlets Road, Ayr, N.B. ... ... ... (E) Nov. 1901
Fownes, Henry, 6, Osborne Road, Jesmond, Newcastle-upon-Tyne (F M) Nov. 1884
Fox, Carter, 7, Coxon Street, Sunderland ... ... (E) { Graduate, Feb. 1898 / Member, Dec. 1899
Fox, Samson, Grove House, Harrogate (*Life Member*) ... ... (E) Dec. 1887
Fox, William, 9, Winfield Terrace, Chester Road, Manchester ... (E) April 1895
France, Alfred Brown, 12, Bright Street, Middlesbrough ... (E) Feb. 1900
Franki, J. P., c/o Messrs. Morts Dry Dock and Engineering Co., Sydney, N.S.W., Australia ... ... ... ... ... (E) Jan. 1886
Fraser, John Holt, c/o Messrs. A. & R. Brown & Co., 90, Regent Road, Liverpool ... ... ... ... (E) { Graduate, Oct. 1895 / Member, Jan. 1898
Fraser, Thomas S., 12, Edinburgh Road, Armley, Leeds ... ... (E E) Jan. 1894
Friederichs, Herbert F., 1, Stanhope Avenue, West Hartlepool (E E) Mar. 1901
Fuller, Philip S., 189, Cardigan Terrace, Gateshead-on-Tyne ... (E) Nov. 1899
Furneaux, J. B., Victoria Engine Works, Gateshead-on-Tyne ... (E) Nov. 1885

G.

Gaine, Roger L., Hartlepool Engine Works, Hartlepool (E) { Graduate, Dec. 1887 / Member, Oct. 1894
Gannaway, H. G., 7, Oxford Terrace, Renfrew, N.B. ... ... (S) Nov 1884
Garelli, Fabio, c/o Messrs. Odero fu Alessº, Sestri-Ponente, Italy (S) Oct. 1896
Garmey, John, Prince Line, Ltd., Produce Exchange, New York ... (E) Dec. 1898
Garthwaite, John R., c/o Messrs. R. Ropner & Sons, Stockton-on-Tees (S) May 1889
Gates, George, Walworth Terrace, Park Road, West Hartlepool ... (E) Jan. 1899
Gayner, Robt. H., Jun., West Bank, Sunderland ... (E) { Graduate, Mar. 1886 / Member, Oct. 1888
Gearing, Ernest George, Penshurst, Clarence Drive, Harrogate ... (E) Dec. 1892
Geddes, Christopher, 2A, Drury Lane, Water Street, Liverpool ... (E) Oct. 1888
Geddes, Frank, The Grove, Shotley Bridge, Co. Durham ... ... (E) Mar. 1902
Giacomuzzi, Virgilio, c/o Messrs. Nicolo Odero fu Alessandro, Sestri-Ponenti, Italy ... ... ... ... ... ... ... (N A) Nov. 1899
Gibson, H., 162, Roker Avenue, Monkwearmouth, Sunderland ... (S) Nov. 1884
Gibson, J. Hamilton, c/o Messrs. Laird Bros., Birkenhead Iron Works, Birkenhead ... ... ... ...(E) { Graduate, April 1891 / Member, Oct. 1894
Gibson, William Wright, 162, Roker Avenue, Sunderland ... (S) Nov. 1900
Gibson, W. H., 37, Tatham Street, Sunderland ... ... ... (E) Nov. 1884

ELECTED.

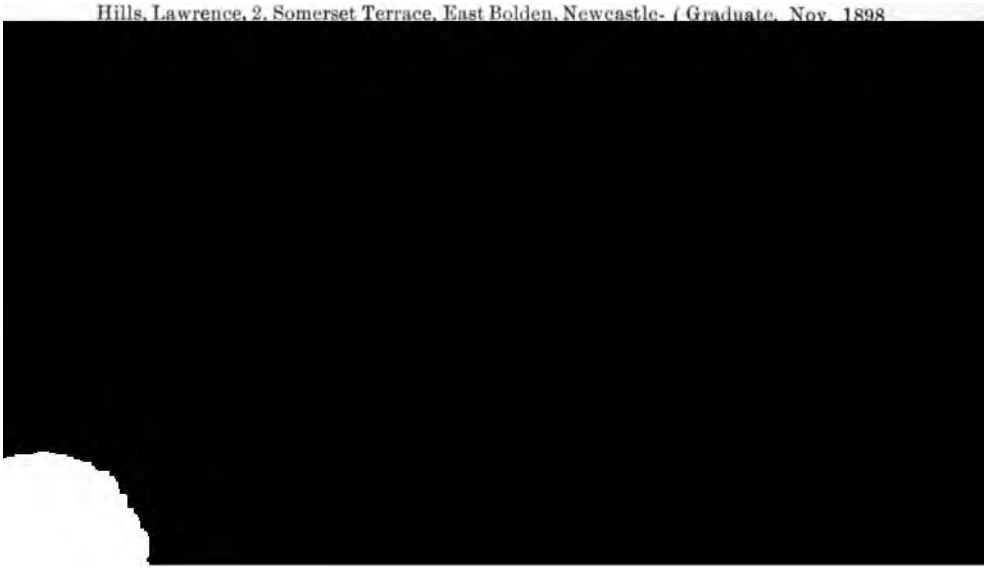
Gray, A., 1, South Parade, Newcastle-upon-Tyne ... ... ... (E) Nov. 1888
Green, J. W., 3, Shaftesbury Place, Gateshead-on-Tyne ... (I & S M) May 1901
Green, W. G., Churchill Street, Willington Quay-on-Tyne ... (E) Nov. 1884
Griffith, Edwin, Messrs. The Wallsend Slipway and Engineering Co., Wallsend-on-Tyne ... ... ... ... ... ... (E) Nov. 1897
Grimes, Thomas Benjamin, 39, Vespasian Avenue, South Shields... (E) Mar. 1890
Gulston, A., Clayton Park Lodge, Jesmond, Newcastle-upon-Tyne (E) Dec. 1888
Gunn, Sir John, Chairman, Messrs. Mount Stuart Dry Docks Co., Cardiff (*Life Member*) ... ... ... ... ... ... June 1896

H.

Hall-Brown, Edward, St. Helens Engine Works, Govan, Glasgow (E) May 1902
Hall, Edward, 68, Grange Road West, Jarrow-on-Tyne ... ... (S) Nov. 1885
Hall, J. Percy, Carville, Lawrie Park Road, Sydenham, London, S.E. (E) Oct. 1885
Hall, John, 54, Westoe Parade, South Shields ... ... ... (E) May 1900
Hall, Thomas, 29, Selbourne Road, Ilford, London, E. ... ... (E) Nov. 1899
Hamilton, Andrew, 19, James Street, Liverpool ... ... ... (CE) April 1901
Hamilton, James, Beech House, Mile End, Stockport (E) { Graduate, Nov. 1897 / Member, Dec. 1901
Hammar, Hugo G., Lindholmens, Verkstads Alstieholag, Göteberg, Sweden ... ... ... ... ... ... ... ... (S) Nov. 1890
Hammersley, B. J., c/o Messrs. Tyne Brass and Copper Tube Manufacturing Co., Jarrow-upon-Tyne ... ... ... (E) May 1901
Hammond, Fleetwood C., c/o Messrs. Cowpen Coal Co., Ltd., Cowpen Colliery, Blyth ... ... ... ... (E) { Graduate, Nov. 1899 / Member, Dec. 1901
Haramüshi, M., Jun., Mitsu Bishi Dockyard and Engine Works, Nagasaki, Japan ... ... ... ... ... ... ... (N A) Nov. 1897
Harbottle, Thomas, 5, Alexander Terrace, Newcastle-upon-Tyne (E) Jan. 1900
Hardy, Henry Thomas, 10, The Retreat, Sunderland ... ... (S) Dec. 1899
Harkness, Richard, Grange Road, West Hartlepool ... (S SUR) Nov. 1884
Harlow, F., 8, Benton Terrace, Newcastle-upon-Tyne ... ... (E) Nov. 1884
Harman, Bruce, Messrs. The Linde British Refrigerating Co., 35, Queen Victoria Street, London, E.C. ... ... ... ... (E) Oct. 1886
Harper, J. H., 1, Beaumont Street, North Shields ... ... ... (E) Jan. 1885
Harris, Anthony, 73, Queen Victoria Street, London, E.C. ... (E) Mar. 1892
Harris, John, Truro House, Hotspur Street, Tynemouth ... ... (E) Dec. 1902
Harrison, Alfred, c/o Messrs. Richardsons, Westgarth & Co., Scotia Engine Works, Sunderland (*Life Member*) ... (E) Oct. 1889
Harrold, Alexander, 26, Park Road, Newcastle-upon-Tyne ... (E) Nov. 1884
Harrold, F., 30, Park Road, Newcastle-upon-Tyne ... ... ... (E) Nov. 1888
Harroway, George Mitchell, 18, West Terrace, North Ormesbey, Middlesbrough ... ... ... ... ... ... ... (S) Jan. 1896
Hartley, W. A., c/o Messrs. Charles Cammell & Co., Cyclops Works, Sheffield ... ... ... ... ... ... ... (E) Jan. 1898
Harvey, John W. J., 1, Richmond Villa, Chertsey Road, Redland, Bristol ... ... ... ... ... ... ... ... (E) Feb. 1889
Haswell, Wm. Spence, c/o Messrs. Tangye, Ltd., 3, St. Nicholas Buildings, Newcastle-upon-Tyne ... ... ... ... ... (E) Oct. 1900
Haussman, B., c/o Messrs. Borneo Co., Limited, 28, Fenchurch Street, London, E.C. ... ... ... ... ... ... (E) Feb. 1899

ELECTED.

Hay, John, 7, Linden Mansion, Hornsey Lane, Crouch End, London, N. ... ... ... ... ... ... ... ... (E) Nov. 1901
Hayhurst, James, 41, Warrington Road, Newcastle-upon-Tyne .. (C E) Nov. 1901
Head, William, Manager, Victoria Shipyard, Goole ... ... (S) Feb. 1901
Headlam, Robert, New Park Terrace, Hartburn Lane, Stockton-on-Tees ... ... ... ... ... ... ... ... ... (E) Nov. 1886
Heaviside, Arthur West, 7, Grafton Road, Whitley Bay, Northumberland ... ... ... ... ... ... ... (E E) Oct. 1896
Heck, John H., Lloyd's Register of Shipping, 3, St. Nicholas' Buildings, Newcastle-upon-Tyne ... ... ... (S SUR) Nov. 1885
Henderson, Alex., c/o Messrs. Empreza, Nacional, De. Nav. D'Vapor, Lisbon ... ... ... ... ... ... ... ... (E) April 1893
Henderson, A. M., 3, Greatham Terrace, West Hartlepool ... (E) Nov. 1890
Henderson, George, 54, Westmorland Road, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Nov. 1884
Henderson, John, 96 Plasturton Avenue, Canton, Cardiff ... ... (E) June 1896
Henry, William P., Cragside, St. Aidan's Road, South Shields ... (E) April 1897
Henshall, Samuel, c/o Messrs. Sir Raylton Dixon & Co., Middlesbrough ... ... ... ... ... (S) { Graduate, May 1885 / Member, Jan. 1894
Hepburn, Alfred, c/o Messrs. N.E. Marine Engineering Co., Northumberland Forge, Wallsend-on-Tyne ... ... ... (F M) Dec. 1890
Hepburn, James M., 17, Grosvenor Place, Newcastle-upon-Tyne ... ... ... ... ... ... (E) { Graduate, Nov. 1895 / Member, Dec. 1901
Hepple, W., Messrs. Hepple & Co., Wapping Street, South Shields ... ... ... ... ... ... ... ... (E & S) Oct. 1881
Hepple, W. T., Messrs. Hepple & Co., Wapping Street, South Shields ... ... ... ... ... ... ... ... (E) Dec. 1893
Hesketh, Thomas, Bryn Tirion, Richmond Road, Cardiff ... ...(SUR) April 1896
Heslop, Thomas, 6, Eldon Place, Newcastle-upon-Tyne ... ... (E) Dec. 1900
Hetherington, William, 27, Co-operative Terrace, Sunderland ... (S) Dec. 1899
Hewison, Herbert, 2, Ewing Road, Queens Crescent, Sunderland .. (S) Dec. 1900
Higginbotham, George Emerton, Glenthorn, Midhurst Road, Benton, Newcastle-upon-Tyne ... ... ... ... ... (E) Nov. 1900
Higgins C. F., c/o Messrs. T. Richardsons, Westgarth & Co., Hartlepool Engine Works, Hartlepool... ... ... ... (E E) Feb. 1898
Hildrey, A. J., 11, Newcastle Road, Sunderland ... ... ... (S) Nov. 1884
Hill, Maxwell, 7, The Side, Newcastle-upon-Tyne ... ... ... (N A) Nov. 1884
Hills, Lawrence, 2, Somerset Terrace, East Bolden, Newcastle- ( Graduate, Nov. 1898



ELECTED.

Holmes, John H., Wellburn, Jesmond Dene Road, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E E) Jan. 1888
Hougland, Even, Lloyd's Surveyor, Bergen, Norway ... ... (E) Dec. 1896
Houston, John, 7 Thornhill Crescent, Sunderland ... ... ... (E) Nov. 1894
Hughes, Thos. Charles, 3, Summerhill Street, Newcastle-upon-Tyne ... ... ... ... ... ... (E) { Graduate, Nov. 1893 / Member, Nov. 1897
Humphreys, George, 24, Mayfield Road, Gosforth, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Jan. 1902
Hunt, Allen E., 11, St. Cuthbert's Terrace, Bensham, Gateshead (SUR) Feb. 1901
Hunter, George B., Messrs. C. S. Swan, Hunter & Co., Wallsend-on-Tyne ... ... ... ... ... ... ... ... (S) Nov. 1884
Hunter, George Ernest, Aykleyheads, Durham ... (S) { Graduate, Feb. 1898 / Member, Nov. 1899
Hunter, Joseph Gilbert, Lloyds Register of Shipping, P.O. Box No. 671, Newport News, Va., U.S.A. ... ... ... (SUR) Feb. 1900
Hunter, J. W., 22, Argyle Square, Sunderland ... ... ... (E) May 1885
Hunter, Summers, c/o Messrs. N.E. Marine Engineering Co., Northumberland Engine Works, Wallsend-on-Tyne ... ... (E) Nov. 1885
Hutchinson, C. W., 6, Park Parade, Westmorland Road, Newcastle-upon-Tyne ... ... ... ... ... ... ... (E) Nov. 1884
Hutchinson, Wesley, B.A., 4, High Street, Newton Heath, Manchester ... ... ... ... ... ... ... ... (E) Oct. 1891
Hutchison, J., Board of Trade Offices, Middlesbrough ... ...(SUR) Dec. 1891
Hyslop, Alfred M., c/o Messrs. Boothroyd, Hyslop & Co., Akenside Street, Bootle, Liverpool ... ... ... ... ... (E) Mar. 1900

I.

Inglis, John, c/o Messrs. Hawthorn & Co., Leith ... ... ... (S) April 1887
Inglis, John, LL.D., Pointhouse Shipyard, Partick, Glasgow (E & S) Oct. 1886
Irvin, Matthew B., Government Arsenal, Alexandria, Egypt ... (E) Oct. 1900
Irwin, J. H., Mowbray Terrace, Sunderland ... ... ... ... (E) Nov. 1884
Ito, Kumezo, Mitsu Bishi Dockyard and Engine Works, Nagasaki, Japan ... ... ... ... ... ... ... ... (E) Dec. 1900

J.

Jack, Charles Kellie, c/o Messrs. Ropner & Sons, Shipbuilders, Stockton-on-Tees ... ... ... ... ... ... ... (S) Nov. 1897
Jack, William C., c/o Messrs. The Hong Kong & Whampoa Dock Co., Limited, Hong Kong, China ... ... ... ... (E) Nov. 1894
Jack, Fred Barrie, Messrs. Worthington Pumping Engine Co., 32, Grainger Street, West, Newcastle-upon-Tyne ... ... (E) Nov. 1901
Jackson, Albert S., 3, Mount Stuart Square, Cardiff ... ... (E) Mar. 1896
Jackson, William S., Messrs. Gourlay Bros. & Co., Camperdown Shipyard, Dundee... ... ... ... ... ... ... (S) April 1891
James, M. C., 6, Park Terrace, Gateshead-on-Tyne ... ... (S) Nov. 1884
Jarvis, Harry Robert, 14, Burnfoot Terrace, Whitley Bay, Northumberland ... ... ... ... ... ... ... (S) Feb. 1901
Jarvis, Horace William, West Dyke, Coatham, Redcar ... ... (E) May 1902
Jennings, Frederick W., 9, New Walk, Leicester .. ... ... (E) Feb. 1898
Jobling, W. J., 1, Akenside Hill, Newcastle-upon-Tyne ... (E & S O) Nov. 1884

ELECTED.

Jobson, Robert, Jun., Rhenass, Clifton Avenue, West Hartlepool (S) Feb. 1898
Johnson, Alexander A., Bank Chambers, Sandhill, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Feb. 1893
Johnson, Johan, 7, Vestra Hamngaten, Gothenburg, Sweden ... (S) May 1885
Johnson, Joseph, Bentham Buildings, Side, Newcastle-upon-Tyne (E) May 1901
Johnson, T. Allan, 64, Cathedral Road, Cardiff ... ... ... (S) Nov. 1884
Johnstone, William, Lloyd's Register of Shipping, 14, Cross-shore Street, Greenock ... ... ... ... ... ... ...(SUR) Nov. 1884
Jones, George, c/o Messrs. W. Gray & Co., Shipyard, West Hartlepool ... ... ... ... ... ... ... ... ... (S) Oct. 1888
Jubb, Arthur, 29, Coldwell Terrace, Felling-on-Tyne ... ... (E) Jan. 1900

K.

Keene, H. R., Lloyd's Register of Shipping, Ouest Quai, 28, Katendyk, Antwerp ... ... ... ... (E) { Graduate, May 1885 / Member, April 1887
Kendall, Stonard O., Lloyd's Register of Shipping, Ramsden Square, Barrow-in-Furness ... ... ... ... ...(SUR) Mar. 1891
Kennedy, William, 14, Gladstone Street, Hartlepool ... ... (E) April 1900
Kerfoot, James, Rue Osy, 20, Antwerp ... ... ... ... (E) Oct. 1892
King, John, Surveyor's Office, Board of Trade, Liverpool ... ... ... ... ... ... ... (S) { Graduate, Dec. 1890 / Member, Oct. 1892
Kirby, John Storm, 4, Westoe Terrace, South Shields ... ... (E) Mar. 1899
Kirkaldy, John, 21, Ground Floor, Leadenhall House, 101, Leadenhall Street, London, E.C. ... ... ... ... (E) Nov. 1885
Kitching, J. F., 134, Fenchurch Street, London, E.C. ... ... (E) Nov. 1890
Kyle, Norman M. W., 26, Sandhill, Newcastle-upon-Tyne ... (E) Nov. 1898

L.

Lace, Basil T., Lyncombe Rise, Bath ... ... ... (E) { Graduate, Nov. 1895 / Member, Nov. 1897
Laidler, William, Messrs. The Upper Tyne Engineering Co., Skinnerburn Road, Elswick, Newcastle-upon-Tyne ... ... (E) Nov. 1901
Laing, Andrew, c/o Messrs. Wallsend Slipway and Engineering Co., Wallsend-on-Tyne ... ... ... ... ... ... (E) Oct. 1892
Laing, Hugh, Deptford Shipyard, Sunderland ... ... ... (N A) April 1897
Laing, John, 5, Tynemouth Road, Heaton, Newcastle-upon-Tyne (E) Nov. 1884
Landreth, Cowen, 34, Simonside Terrace, Newcastle-upon-Tyne ... (E) Mar. 1896
Larkin, James, Tyne View, East Jarrow-on-Tyne ... ... ... (E) Nov. 1884
Latta, James G., 78, Billiter Buildings, Billiter Street, London, E.C. (C E) Mar. 1902
Leathard, Thomas Surtees, 9, Otto Terrace, Sunderland ... ...(SUR) April 1899
Lee, Hugh Warren, 88, Manor House Road, Jesmond, Newcastle-upon-Tyne ... ... ... ... (E) { Graduate, Dec. 1899 / Member, Jan. 1902
Lewins, Frank, Rosehill, Willington-on-Tyne ... ... ... (E) Dec. 1895
Lewis, R. A., Newburn Steel Works, Newburn-on-Tyne ... ... (E) Nov. 1884
Liddell, J., c/o Messrs. W. Denny & Co., Engine Works, Dumbarton (E) Nov. 1884
Lie, Gotfred, Det Bergenske Dampskibsselskab, Bergen ... ... (E) Jan. 1895
Lindberg, George, Studsgarden 8, Stockholm ... ... (N A & C E) Nov. 1901
Lindfors, Hugo, Surveyor to Lloyd's Register of Shipping, 16, Alexandersgatan, Helsingfors, Finland ... ... (SUR) May 1889
Lineham, Wilfrid J., Jesmond, Leyland Road, Lee, London, S.E. (E) Oct. 1890
Link, Rolls Percival, 126, Pilgrim Street, Newcastle-upon-Tyne ... (C E) Mar. 1901

ELECTED.

Lishman, John J., Jun., 16, Lovaine Place, North Shields ... ... ... ... ... ... (E) { Graduate, Dec. 1892 / Member, May 1900

Little, Frank, 31, Westgate Road, Newcastle-upon-Tyne ... ... (E E) April 1902

Littleboy, Chas. Wm., The Woodlands, Saltburn-by-the-Sea ... (S) Oct. 1887

Littledale, John W. E., c/o. Messrs. Charing Cross & City Electricity Co., Cannon Street Sub-station, All Hallows Lane, London, W.C. ... ... ... ... ... ... ... ... (E) May 1896

Livingston, Thos. L., Dunedin House, Jarrow-on-Tyne ... ... (S) Nov. 1884

Lohmeyer, H., 53, Crown Street, Newcastle-upon-Tyne ... ... (E) Nov. 1884

London, William Jas. Albert, c/o Messrs. Brown, Boveri, & Co., Ltd., Baden, Switzerland ... ... ... (E) { Graduate, May 1898 / Member, May 1901

Long, A. E., 124, Albert Road, Jarrow-on-Tyne ... ... ... (S) Nov. 1884

Loveridge, Wm. Henry, York Road, West Hartlepool ... ... (E) Feb. 1901

Lowdon, John, Messrs. The Barry Graving Dock and Engineering Co., Limited, Barry Dock, near Cardiff ... ... ... (E) Dec. 1891

Lumley, William, c/o Messrs. Witting Bros., 42, Cannon Street, London, E.C. ... ... ... ... (E) { Graduate, June 1896 / Member, Oct. 1898

Lumley, Gascoigne, Bonny, Southern Nigeria ... ... ... (E) Nov. 1901

Lund, Pearson, Messrs. Noble & Lund, Northern Machine Tool Works, Felling-on-Tyne ... ... ... ... ... ... (E) Nov. 1900

## M.

MacColl, Hector, Bloomfield, Belfast ... ... ... ... (E) Dec. 1890

MacColl, Hugo, Wreath Quay Engineering Works, Sunderland (*Life Member*) ... ... ... ... ... ... ... (E) Nov. 1896

Maccoy, John, Springfield, Gateshead-on-Tyne ... ... ... (E) Feb. 1886

Macdonald, Charles, 4, St. Nicholas' Buildings, Newcastle-upon-Tyne ... ... ... ... ... ... ... ...(SUR) Feb. 1898

MacDonald, David R., c/o Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., Walker Shipyard, Newcastle-upon-Tyne (S) Nov. 1891

Macdonald, John C., c/o Messrs. N.E. Marine Engineering Co., Northumberland Engine Works, Wallsend-on-Tyne ... ... (E) Nov. 1899

MacDonald, John, 9, York Street, Glasgow ... ... ... ... (E) Dec. 1900

Mace, W., 253, Albert Road, Jarrow-on-Tyne ... ... ... (E) Jan. 1886

Macfarlane, Archibald P., 15, Beacon Street, Low Fell, Gateshead-upon-Tyne ... ... ... ... ... ... ... ... (E) Mar. 1902

Macgregor, W. L., Board of Trade Surveyors' Offices, Blyth ...(SUR) Mar. 1899

MacHaffie, John, 635, Terrace Place, Schenectady, New York, U.S.A. (E) Dec. 1885

Mackay, William, 15, Camperdown Road. Scotstoun, Renfrewshire ... ... ... ... ... ... ... ... (S) Mar. 1892

Mackley, Edward N., 97, Enfield Road, Elswick, Newcastle-upon-Tyne... ... ... ... ... ... ... ... (E) April 1901

MacMillan, H. M., B.Sc., 58, Fern Avenue, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (S) Jan. 1902

Mail, M., Jun., c/o Messrs. Middle Dock and Engineering Co., South Shields ... ... ... ... ... ... ... (E) Nov. 1897

Manaira, Guiseppe, 4, Salita S Gerslamo, Genoa, Italy ... (E & N A) Nov. 1893

Manning, Henry Lewis, R.N., Sea View, Ryhope, Sunderland ... (E) Dec. 1900

Marr, James, c/o Messrs. J. L. Thompson & Sons, North Sands Shipyard, Sunderland ... ... ... ... ... ... (S) Nov. 1884

Marshall, F. C., Akenside Lodge, Newcastle-upon-Tyne (*Life Member*) (E) Nov. 1884

ELECTED.

Marshall, Frank T., Messrs. R. & W. Hawthorn, Leslie & Co., St. Peter's, Newcastle-upon-Tyne ... ... (E) — Graduate, Jan. 1885; Member, Oct. 1888

Marshall, R. J., 53, Larkspur Terrace, Jesmond, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... (E) Mar. 1887

Marshall, Robert, 12, Broughton Road, South Shields ... ...(SUR) Mar. 1901

Maslen, Frank E., The Priory, Hampstead Heath, London, N.W. ... ... ... ... ... ... (E) — Graduate, Nov. 1891; Member, May 1898

Mason, George F., Lloyds' Bank Buildings, Mount Stuart Square, Cardiff ... ... ... ... ... ... ... ... (E) Oct. 1895

Mather, Charles, 60, St. George's Terrace, Newcastle-upon-Tyne (SUR) Oct. 1888

Mather, Clifford Basil, Lesbury House, Lesbury, R.S.O. (NA) — Graduate, Oct. 1892; Member, Oct. 1898

Mather, Thomas Brewer, 13, Park Avenue, Whitley Bay, Northumberland ... ... ... ... ... ... ... ... ... (C E) Nov. 1898

Matheson, William, c/o Messrs. R. & W. Hawthorn, Leslie & Co., Hebburn-on-Tyne... ... ... ... ... ... ... (S) Dec. 1889

Mathieson, Donald, 30, Jackson Street, Sunderland ... ... (E) Nov. 1898

Matthews, A., Laureldyne, Midhope Road, Woking, Surrey ... (S) Nov. 1884

Matthews, Jas., c/o Messrs. R. & W. Hawthorn, Leslie & Co., Forth Banks, Newcastle-upon-Tyne ... ... ... ... ... (E) Oct. 1886

Maughan, Philip A., 8, Ashleigh Grove, West Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... ... (S) Dec. 1900

Maxwell, Thomas, 15, Ashfield Terrace, East, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Nov. 1899

Maxwell, William Ward, B.Sc., Messrs. H. Charlton & Co., Engineers, Gateshead-on-Tyne ... ... ... ... ... (E) Dec. 1896

McBride, William, Hartburn, Cleveland Road, Hartlepool ... (E) Dec. 1894

McCoull, Cecil, 94, Drayton Park, Highbury, London, N. (EE) — Graduate, Oct. 1895; Member, Dec. 1901

McGillivray, Peter, 14, Normanton Terrace, Newcastle-upon-Tyne (E) Nov. 1899

McGlashan, Arch., Beechcroft, Clifton Avenue, West Hartlepool (S) Nov. 1885

McGregor, Duncan, 5, Bishopton Street, Sunderland ... ... (S) Dec. 1899

McIlvenna, J. G., c/o Messrs. The Tyne Pontoons and Dry Docks Co., Wallsend-on-Tyne ... ... ... ... ... ... (S) Nov. 1884

McKechnie, James, Messrs. Vickers, Sons & Maxim, Naval Construction Works, Barrow-in-Furness ... ... ... ... (E) April 1896

McKenna, Francis, c/o Messrs. E. F. Wailes & Co., 4, St. Nicholas' Buildings, Newcastle-upon-Tyne ... (E) — Graduate, Dec. 1890; Member, Dec. 1896

ELECTED.

Messenger, Thomas, "Greeba," Matham Road, East Molesey, Surrey ... ... ... ... ... ... ... ... (E) Mar. 1887

Metcalf, Thos., 18, John Street, Sunderland... ... (S) { Graduate, May 1885 / Member, Nov. 1893

Metcalfe, C. S., 24, Croft Avenue, Sunderland ... ... ... (E) Nov. 1884

Meuwissen, J., 18, Esplanade, Whitley Bay, Northumberland ... (E) Nov. 1899

Micheli, Pietro, Jun., Via Sottoripu, No. 1, piano nobile, Genoa, Italy ... ... ... ... ... ... ... ... (E & N A) Oct. 1888

Middlemass, Thomas, 3, Albert Place, Norton Road, Stockton-on-Tees... ... ... ... ... ... ... ... ... ... (S) Oct. 1889

Middleton, H., 20, Lynnwood Avenue, Newcastle-upon-Tyne (I & S M) Jan. 1893

Middleton, Robert Alexander, 20, The Grove, Benton, near Newcastle-upon-Tyne ... ... ... ... ... ... (N A) Oct. 1892

Millar, Thos., c/o Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., Walker Shipyard, Walker-on-Tyne ... ... ... (S) Nov. 1884

Milton, James Edward, Messrs. Lloyd's Register of Shipping, 71, Fenchurch Street, London, E.C. ... ... ... ...(SUR) Nov. 1900

Milton, J. T., Lloyd's Register of Shipping, 71, Fenchurch Street, London, E.C. ... ... ... ... ... ... (E SUR) Nov. 1886

Mitchell, Wm., Glen Street, Hebburn-on-Tyne ... (S) { Graduate, Jan. 1898 / Member, Feb. 1901

Moffatt, James, 7, Murray's Terrace, Belfast, Ireland (E) { Graduate, Dec. 1889 / Member, Oct. 1892

Moffatt, William Graham, 44, Lennox Avenue, Scotstoun, Glasgow (E) Mar. 1899

Moffitt, George, c/o Messrs. The Blyth Shipbuilding Co., Blyth ... (S) Oct. 1888

Moffoot, Alexander, 32, Eldon Street, Chester Road, Sunderland.. (S) Mar. 1898

Moncrieff, John M., 2, St. Nicholas' Buildings, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... (C E) Dec. 1899

Moody, Thomas V., c/o Messrs. Scott Bros., 46, Sandhill, Newcastle-upon-Tyne ... ... ... ... ... ... ... (E) Dec. 1887

Moore, Wm. Henry, c/o Messrs. Workman, Clark, & Co., Engine Works, Spencer Basin, Belfast ... ... ... ... ... (E) Nov. 1897

Morgan, John Osborn, Bank Chambers, Sandhill, Newcastle-upon-Tyne... ... ... ... ... ... ... ... (CE) Feb. 1901

Morgan, W. H., 22, Rochdale Street, Wallsend-on-Tyne ... ... (E) Nov. 1884

Morison, D. B., Hartlepool Engine Works, Hartlepool ... ... (E) Feb. 1885

Mörk, Peter, 31, Holsteinsgude, Copenhagen ... ... ... (E) Nov. 1884

Moroney, E. F., 24, King John Terrace, Heaton, Newcastle-upon-Tyne ... ... ... ... ... ... (E) { Graduate, Feb. 1892 / Member, Nov. 1899

Morrison, Robt., Highfield, St. Aidan's Road, South Shields ... (E) Nov. 1886

Morrison, William, Lloyd's Register of Shipping, Maritime Buildings, Dundee ... ... ... ... ... (E SUR) Oct. 1890

Morton, Richard Fraser, Lloyd's Register of Shipping, 24, George Street, Sheffield ... ... ... ... ... ... (E SUR) Oct. 1890

Moss, William, Kirkview, Shipley, Yorkshire ... (E) { Graduate, Jan. 1898 / Member, Dec. 1901

Mould, Francis H., 37, Hawthorn Road, Gosforth, Newcastle-upon-Tyne ... ... ... ... ... ... (E) { Graduate, Feb. 1892 / Member, Jan. 1897

Mountain, William Chas., Messrs. Ernest Scott, Mountain, & Co., Close, Newcastle-upon-Tyne ... ... ... ... ... (E E) Feb. 1889

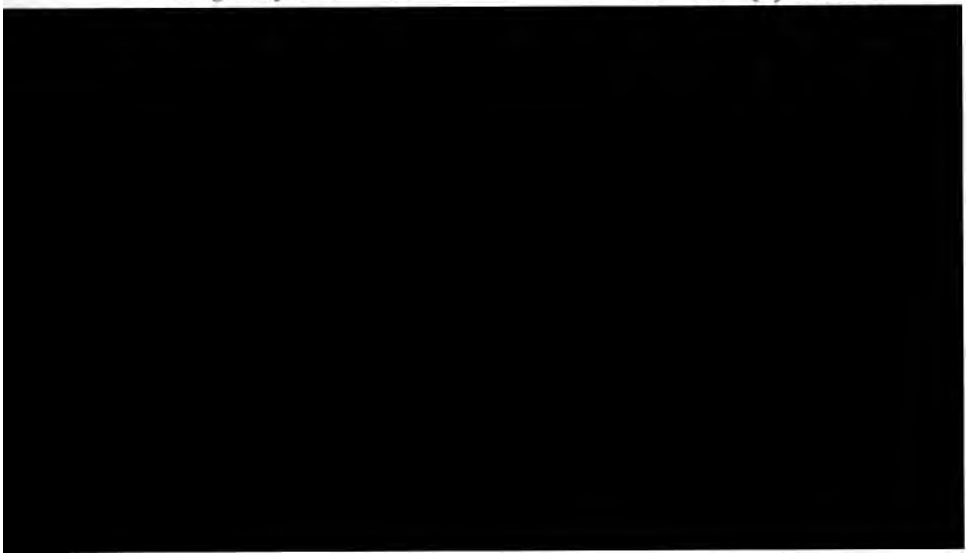
Muir, Alfred Edward, Messrs. J. L. Thompson & Sons, North Sands Shipyard, Sunderland ... ... ... ... ... ... (S) Mar. 1893

ELECTED.

Muir, Chas. M., 32, William Street, Newcastle Road, Sunderland... (S) May 1899
Muir, Robert, 11, Clarence Crescent, Whitley Bay, Northumberland ... ... ... ... ... ... ... ...(SUR) Oct. 1886
Muir, Robert Home, 1, Lovaine Crescent, Newcastle-upon-Tyne ... (S) Oct. 1892
Munck, Ove. Holger, c/o Messrs. Burmeister & Wain, Shipbuilders, Copenhagen, Denmark ... ... ... ... ... ... (S) Feb. 1899
Munro, James, 34, Garthland Drive, Dennistoun, Glasgow ... (E) Mar. 1901
Murray, Charles W., c/o Messrs. Babcock & Wilcox, Ltd., Ogle House, Farringdon Street, London, E.C. ... ... ... (E) May 1901
Musgrave, Evers, 8, Lastingham Terrace, Frilford, York (E) { Graduate, Nov. 1891 / Member, Oct. 1895
Myles, David, c/o Messrs. N.E. Marine Engineering Co., Northumberland Engine Works, Wallsend-on-Tyne ... ... ... (E) Nov. 1884

## N.

Nastoupil, John, Chief Engineer, Austro-Hungarian Navy, Marine Casino, Pola, Austria ... ... ... ... ... ... (E) Nov. 1890
Neill, William Reid, 15, Salem Hill South, Sunderland ... ... (E) Dec. 1897
Nellist, George, 2, Burdon Road, Sunderland ... ... ... (E) Nov. 1901
Nelson, George, c/o Messrs. Blyth Foundry and Engineering Co., Blyth ... ... ... ... ... ... (E) { Graduate, Jan. 1900 / Member, Dec. 1901
Nevins, William, Hazel Rrae, Bradford Road, Shipley, Yorkshire (E) Mar. 1894
Nevison, Thomas C., 18 Milton Road, West Hartlepool ... ... (E) April 1900
Nicholls, H. E., 25, Churchill Street, Sunderland ... ... ... (E) Nov. 1893
Nichols, Walter W., 4 South View, London Road, Peterborough ... (E) May 1895
Nicholson, P. F., c/o Messrs. R. & W. Hawthorn, Leslie, & Co., Hebburn-on-Tyne ... ... ... ... ... ... ... (S) Feb. 1901
Nicholson, John S., North View, Mowbray Road, Westoe, South Shields ... ... ... ... ... ... ... ... (E) Nov. 1893
Nicholson, Joseph Cook, City Road Tool Works, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Feb. 1897
Nicholson, Thos. Head, 90, Rye Hill, Newcastle-upon-Tyne ... (E) Nov. 1897
Nicol, John M., 15, Linskill Terrace, North Shields ... ... (E) Nov. 1884
Nicolson, G. C., 8, York Terrace, New Brompton, Kent (E) { Graduate, Oct. 1885 / Member, Oct. 1888
Niven, William A., 6, Jackson Street, Walker-on-Tyne ... ... (E) Nov. 1898
Noble, Harry, Northern Machine Tool Works, Brewery Lane, Felling-on-Tyne ... ... ... ... ... ... ... (E) Nov. 1888



ELECTED.

Ord, Godfrey C., 4, The Esplanade, Sunderland ... ... ...(E E) Jan. 1897
Orde, E. L., c/o Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., Walker Shipyard, Newcastle-upon-Tyne ... ... (E) Oct. 1887
Orlando, Chev. Giuseppe, Cantiere Navale, Fratelli Orlando, Leghorn ... ... ... ... ... ... ... ...(N A) Jan. 1893
Ormonde, John Grey, 35, Percy Gardens, Tynemouth ... ... (E) Nov. 1897
Orr, John, Prof., B.Sc., Kimberley Club, Kimberley, South Africa (E) Mar. 1897
Ortton, Alfred R., 27, General Graham Street, Chester Road, Sunderland ... ... ... ... ... ... ... (E) Nov. 1898,
Ostens, Joseph, 4, Jackson Street, North Shields ... .. ... (S) Nov. 1900
Owens, J. Switzer, B.A., Carleys Bridge House, Enniscorthy, Ireland ... ... ... ... ... ... ... .. (E) Oct. 1898
Oxley, G., 51, Norman Terrace, Howdon-on-Tyne ... ... ... (S) Nov. 1884
Oxton, Walter, 5, Beech Lane, Stretton, near Burton-on-Trent ... ... ... ... ... ... ... (E) { Graduate, Dec. 1890 / Member, May 1894

P.

Paget, John W., 9, Meldon Terrace, Heaton, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (S) Dec. 1900
Parker, James H., 11, Gladstone Street, Hartlepool ... ... (E) April 1900
Parr, Joseph E., 21, Zion Terrace, Newcastle Road, Sunderland... ... ... ... ... ... ... (S) { Graduate Nov. 1898 / Member, Dec. 1899
Parsons, Hon. Charles A., Turbinia Works, Wallsend-on-Tyne ... (E E) Dec. 1887
Parsons, Harry F., Lindenhurst, Clarence Road, Teddington, Middlesex ... ... ... ... ... ... ... ... (E) Dec. 1890
Pascoe, J. R., Tyrmont, Woodford Green, Essex (*Life Member*) ... (S) Dec. 1889
Patterson, Jas., c/o Messrs. Caldwell & Co., Limited, Elliot Street, Glasgow ... ... ... ... ... ... ... ... (E) Nov. 1884
Patterson, Robert O., Thorneyholme House, Blaydon-on-Tyne ... ... ... ... ... ... ... (E) { Graduate, Jan. 1895 / Member, Dec, 1901
Patterson, Thomas Henry, 2, The Elms, Sunderland .. ... (S) Jan. 1902
Pattison, Jos., Bute Docks, Cardiff ... ... ... ... ... (E) Nov. 1884
Paulin, William J., 24, Oxford Street, Newcastle-upon-Tyne ... (E) April 1897
Paxton, John F., 52, Walker Terrace North, Gateshead ... ... (E) May, 1899
Pearson, James T., 21, First Avenue, Heaton, Newcastle-upon-Tyne ... ... ... ... ... ... (S) { Graduate, Nov. 1893 / Member, Dec. 1897
Peat, Herbert, 12, Cheltenham Terrace, Heaton, Newcastle-on-Tyne (E) Mar. 1902
Penney, R. H., Board of Trade Offices, 79, Mark Lane, London, E.C. ... ... ... ... ... ... ... ... ... (S SUR) Nov. 1884
Pepper, W., 9, West Villas, Oxbridge Lane, Stockton-on-Tees ... (E) Nov. 1888
Perrett, Jos. Richard, c/o Messrs. Sir W. S. Armstrong, Whitworth & Co., Elswick Shipyard, Newcastle-upon-Tyne ... ... (N A) Nov. 1896
Pescod, Joseph Hind, 1, Railway Street, Jarrow-on-Tyne (S) { Graduate, Feb. 1898 / Member, Jan. 1900
Petersen, John L., Havelock House, Victoria Road, West Hartlepool (SUR) Oct. 1888
Petree, James, Lloyd's Register of Shipping, 12, Oriel Chambers, Water Street, Liverpool ... ... ... ... ... (N A SUR) Oct. 1885
Petterson, Carl Edwin, 7, Vestra Hamngaten, Gothenburg, Sweden (E) Oct. 1891
Phayer, Robert P., 27, Edwards Road, Whitley Bay, Northumberland ... ... ... ... ... ... ... ... ... (S) Dec. 1900
Philipson, Roland, Tynemouth... ... ... ... ... ... (E) Dec. 1884

ELECTED.

Phorson, P., Glen Lea, Roker, Sunderland ... ... ... ... (S) Nov. 1884
Piaud, Leon, c/o Messrs. Delanney, Bellville, & Co., St. Denis, France ... ... ... .. ... ... ... ... (N A) Nov. 1888
Pierce, Robert Cecil, 14, West Park Gardens, Kew, Surrey... ... ... ... ... ... ... (E E) { Graduate Dec. 1898 / Member Dec. 1899
Pitt, Frederick William, 552, Chester Road, Old Trafford, Manchester, S.W. ... ... ... ... ... ... (E SUR) Oct. 1890
Poli, Rodolfo, Chioggia, Italy ... ... ... ... ... ... (N A) Jan. 1890
Pollock, Walter, c/o Messrs. Jas. Pollock, Sons, & Co., 22, Billiter Street, London, E.C. ... ... ... ... ... ... (N A) April 1900
Posgate, James S., Durham House, Windmill Street, Gravesend, Kent ... ... ... ... ... ... (E) { Graduate, Nov. 1895 / Member, Dec. 1901
Potts, Cuthbert Ivan, 4, Sidney Road, Bootle, Liverpool .. ... (E) Oct. 1895
Powell, James Richard, Royal Stuart Buildings, Cardiff ... ... (C E) May 1894
Price, John, 6, Osborne Villas, Jesmond, Newcastle-upon-Tyne ... (S) Nov. 1884
Pringle, Alfred, 10, Somerset Terrace, Walker-on-Tyne (S) { Graduate, Dec. 1891 / Member, Jan. 1894
Pringle, James G., 10, Somerset Terrace, Walker-on-Tyne... ... (S) Oct. 1892
Proven, George, 358, Leith Walk, Leith, N.B. ... ... ... (E) Mar. 1901
Purdon, Andrew S., Messrs. Irvine's Shipbuilding and Dry Docks Co., Limited, West Hartlepool ... ... ... ... ... (S) Oct. 1892
Purvis, Andrew Alex., 17, Brook Terrace, Whitley Bay, Northumberland ... ... ... ... ... ... ... (E) Dec. 1899
Purvis, Fred. W., c/o Messrs. Sir W. Gray & Co., Central Shipyard, West Hartlepool ... ... ... ... ... ... ... (S) April 1893
Putnam, T., Darlington Forge, Darlington ... ... ... ... (FM) Nov. 1884

Q.

Quicke, Herbert John, c/o Messrs. Harfield & Co., Blaydon Ironworks, Blaydon-on-Tyne ... ... ... ... ... ... (E) Feb. 1891

R.

Ramage, J. T., St. Aubyn's, Bonnington, Edinburgh ... ... (E) April 1887
Ramage, John Anderson, 72, Glen Terrace, Hebburn-on-Tyne ... (S) Oct. 1892
Ranken, David, 8, Brookside Terrace, Sunderland ... ... ... (E) Nov. 1900
Rappaport, Fred. G., Messrs. Russian Petroleum and Liquid Fuel Co., Baku, South Russia ... ... ... (E) { Graduate, Mar. 1894 / Member, Jan. 1902
Readhead, Jas., Westoe Hall, South Shields ... ... ... (S) Nov. 1884
Readhead, John, Rockcliffe, Westoe, South Shields ... ... (E) Mar. 1886

ELECTED

Reynolds, Charles H., c/o Messrs. Burmeister & Wain, Shipbuilders, Copenhagen, Denmark ... ... ... ... ... ... (S) Mar. 1889
Reynolds, W. G., 14, Grosvenor Road, Newcastle-upon-Tyne ... (E) Oct. 1886
Rhodes, Joseph Henry, Stonyroyd, Oxbridge Lane, Stockton-on-Tees ... ... ... ... ... ... ... ... ... (E) Nov. 1901
Richardson, Sir Thomas, B.A., Hartlepool Engine Works, Hartlepool ... ... ... ... ... ... ... ... (E) April 1888
Richardson, John Lyth, Deddington Chambers, Hull ... ... (E) Nov. 1901
Richardson, Wigham, Wingrove House, Newcastle-upon-Tyne ... (S) Nov. 1884
Rickaby, A. A., 27, Olive Street, Sunderland ... ... ... (E) Mar. 1888
Ridley, J. H., Park End, Wark-on-Tyne ... ... ... ... (E) Nov. 1884
Riley, J. H., Messrs. Riley Bros., Stockton-on-Tees ... ... ... (B B) May 1893
Riseley, Harry Lorimer, Western Villa, Wallsend-on-Tyne ... (E) Nov. 1900
Ritson, Maurice, Lloyd's Register of Shipping, Piazza S. Giorgio, 32, Genoa ... ... ... ... ... ... ... (E SUR) Nov. 1884
Ritson, S. M., 7, Dogo Street, Cardiff ... ... (E Graduate, Nov. 1887; Member, Nov. 1893)
Roberts, W. C., 18, Windsor Road, Forest Gate, Essex ... ... (E) Mar. 1901
Robinson, Charles O., Ingleside, North Shields ... (E) Graduate, Dec. 1893; Member, Nov. 1899
Robinson, William, Delaval House, 3, Broxbourne Terrace, Sunderland ... ... ... ... ... ... ... (E) Graduate, May 1885; Member, April 1888
Robinson, Francis, The Vicarage, Willington Quay-on-Tyne ... ... ... ... ... ... (E) Graduate, Nov. 1897; Member, Jan. 1902
Robson, David M., 11, Village Terrace, South Shields ... ... (E) Nov. 1899
Robson, George, 9, Wellington Terrace, South Shields ... ... (E) Oct. 1889
Robson, George, 140, Aurelian Terrace, South Shields ... ... (E) Feb. 1896
Robson, John H., 22, Eversley Place, Heaton, Newcastle-upon-Tyne (E) Nov. 1885
Robson, J. M., 4, Abbey Terrace, Gateshead-on-Tyne ... ... (E) Nov. 1884
Robson, M., 20, Tavistock Place, Sunderland ... ... ... (S) Nov. 1884
Robson, Nathaniel E., 5, Park Villas, The Green, Wallsend-on-Tyne ... ... ... ... ... ... (E) Graduate, Dec. 1894; Member, Nov. 1897
Robson, John Hayes, 32, Pollard Street, South Shields ... ... (S) Feb. 1902
Robson, Robert, 5, St. Mary's Place, Newcastle-upon-Tyne (EE) Graduate, Dec. 1894; Member, Mar. 1901
Rodgerson, Wm. John, 33, Brunswick Street, Gateshead-on-Tyne (E) Nov. 1901
Roger, Robert. Stockton Iron Foundry, West Row, Stockton-on-Tees (E) Nov. 1888
Rogers, Herbert M., Redcliffe, Durham Avenue, Bromley, Kent (SUR) April 1889
Rolf, George, 8, Bentinck Crescent, Newcastle-upon-Tyne ... (E E) May 1892
Rolland, Alexander, Villa Ruzic, Susak, Fiume, Hungary ... ... (E) Mar. 1892
Ropner, Robert, Jun., Stockton-on-Tees ... ... ... ... (S) Feb. 1886
Rosenthal, James H., Woodville, 97, Eltham Road, Lee, Kent ... (E) Dec. 1896
Roseti, Capt. G. Sundblad, Callao 1442, Buenos Ayres, Argentine Republic ... ... ... ... ... ... ... ... (N A) June 1896
Ross, Charles, c/o Messrs. Smith's Dock Co., Ltd., High Docks, South Shields ... ... ... ... ... ... ... (E) Jan. 1898
Ross, William, 20, Meadow Side, Dundee ... ... ... ... (E) May 1893
Routledge, Herbert J., Stapleton House, Jarrow-on-Tyne ... ... ... ... ... ... (E E) Graduate, Mar. 1897; Member, Dec. 1901
Rowan, Jas., 231, Elliott Street, Glasgow ... ... ... ... (E) Nov. 1886
Rowell, G. W., 22, Armstrong Road, New Benwell, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Feb. 1885

ELECTED.

Rowell, H. B., Cleugh Brae, Jesmond East Park, Newcastle-upon-Tyne (*Life Member*) ... ... ... ... ... ... (S) Nov. 1884
Roxburgh, Allan B., 21, Grafton Road, Whitley Bay, Northnmberland ... ... ... ... ... ... ... ... ... (E) Jan. 1902
Rusden, L., 14, Sanderson Road, Jesmond, Newcastle-upon-Tyne (E) Nov. 1884
Russell, F. Herbert, Scotia Engine Works, Sunderland ... ... (E) Oct. 1891
Rutherford, J. T., 39, Osborne Road, Stroud Green Road, London, N. ... ... ... ... ... ... (E) { Graduate, Jan. 1886 / Member, Nov. 1893
Rutherford, Robert T., 34, Denmark Street, Gateshead-on-Tyne ... (E) Nov. 1899
Ryder, C. L., Messrs. The London Salvage Association, Mount Stuart Square, Cardiff ... ... ... ... ... ... (E) Oct. 1886

S.

Salmon, P., 5, The Oaks West, Sunderland ... ... ... (E SUR) Nov. 1884
Sandeman, John Watt, 2, St. Nicholas' Buildings, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... ... (E) Oct. 1891
Sanderson, J., 31, Park Road, Jarrow-on-Tyne ... ... ... (S) Nov. 1884
Sawyer, John, c/o Messrs. Thos. Wilson, Sons, & Co., Hull ... (E) Oct. 1886
Schaeffer, A. G., 16, Lombard Street, Newcastle-upon-Tyne ... (E) Nov. 1884
Scott, Ernest, Close Engine Works, Newcastle-upon-Tyne ... (E E) Nov. 1884
Scott, George, 36, Bede Burn Road, Jarrow-on-Tyne ... (S) { Graduate, Jan. 1900 / Member, May 1901
Scott, James, c/o Messrs. Consett Iron Co., Blackhill, Co. Durham (E) Oct. 1892
Scott, Joseph, 49, Leazes Terrace, Newcastle-upon-Tyne (E) { Graduate, Dec. 1891 / Member, Oct. 1898
Scott, Joseph R., 9, Queen Street, Newcastle-upon-Tyne ... ... (E) Oct. 1887
Scott, Walter, 28, Hollybrook Road, Clontarf, Dublin ... ... (NA) Mar. 1897
Scott, William, c/o Messrs. R. & W. Hawthorn, Leslie & Co., St. Peter's, Newcastle-upon-Tyne ... ... ... ... ... (E) Nov. 1884
Scott, William, Lyndhurst, 19, Plasturton Avenue, Cardiff ... (E) June 1896
Seabury, Edward, Burnt Mill House, Harlow, Essex ... ... (E) Mar. 1886
Seaman, C. J., Vyrinen House, Old Trafforth, Manchester ... (E) Jan. 1889
Seaton, Albert Edward, Wilton House, Holderness Road, Hull ... (E) Jan. 1891
See, Horace, 1, Broadway, New York City, U.S.A.... ... ... (E) May 1896
Sergent, William John, 4, Hereford Road, Seaforth, near Liverpool ... ... ... ... ... ... ... ... (E) Oct. 1898
Shand, H., 6, Akenside Terrace, Newcastle-upon-Tyne ... ... (E) Nov. 1884
Sharp, A. E., c/o Messrs. The Peninsular and Oriental Steam

ELECTED.

Sinclair, Charles E., 18, James Street, Liverpool ... ... ... (C E) Jan. 1902

Simpson, Kenneth, c/o Messrs. John Brown & Co., Clydebank Shipbuilding Yard, Glasgow ... ... ... (S) { Graduate, Dec. 1893 / Member, Oct. 1895

Sinton, John K., 26, Sandhill, Newcastle-upon-Tyne ... . . (E) Nov. 1885

Sisson, Wm., Gloucester ... ... ... ... ... (E & N A) Oct. 1888

Sivewright, G. W., 5, Radcliffe Terrace, Hartlepool ... ... (S) Nov. 1883

Skentelbery, Charles, c/o Messrs. Jacobs, Davies, and Barringer, 153, Mick Street, Boston, U.S.A. ... ... ... ... (E) Oct. 1900

Skentelbery, Joseph W., 7, Washington Terrace, North Shields ... (E) Dec. 1900

Skinner, Leslie, 22, Ravensbourne Terrace, South Shields (S) { Graduate, Dec. 1886 / Member. Oct. 1891

Smissen, C. V. Van Der, c/o Messrs. Hamburg-American Steamship Co., Hamburg ... ... ... ... ... ... ... (E) Dec. 1901

Smith, C. E., Cowesby, Clifton Avenue, West Hartlepool ... (E) Nov. 1888

Smith, E. J., Brandon House, Haughton-le-Skerne, Darlington ... (E) Dec. 1900

Smith, L. Eustace, Roseworth Cottage, Moor Road, Gosforth, Newcastle-upon-Tyne ... ... ... ... (E) { Graduate, Oct. 1889 / Member, Oct. 1892

Smith, Thomas, Steam Crane Works, Old Foundry, Rodley, near Leeds (E) Oct. 1888

Smith, Thomas Edward, Messrs. John Smith & Sons, Newgate Street, Newcastle-upon-Tyne ... ... ... ... ... (E) April 1885

Smith, Wm., 152, Roker Avenue, Sunderland, M. ... ... ... (E) Nov. 1884

Smith, Wm. Stawart, West Villa, The Green, Wallsend-on-Tyne ... ... ... ... ... ... (S) { Graduate, Nov. 1893 / Member, Dec. 1897

Sneddon, Alex. Russell, Lloyd's Register of Shipping, 3, St. Nicholas Buildings, Newcastle-upon-Tyne ... ... (E SUR) Nov. 1899

Snell, John F. C., Borough Electrical Engineer, Town Hall, Sunderland ... ... ... ... ... ... ... (E E) Mar. 1902

Snook, Francis W. G., 32, Sunbury Avenue, West Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... (E) Dec. 1896

Soliani, Nabor, Col., Direttore del Cantiere Ansaldo, Sestri-Ponente, Italy ... ... ... ... ... ... ... (S) Jan. 1885

Spark, H. King, Messrs. The Anti-Attrition Metal Co., Ltd., Emerson Street, Southwark, London, S.E. ... ... ... (E) May 1898

Spearman, Richard, Eachwick House, Dalton, Newcastle-upon-Tyne (E) Feb. 1889

Spence, W. G., c/o Messrs. Wigham Richardson & Co., Neptune Works, Walker-on-Tyne (*Life Member*) ... ... ... (E) Nov. 1884

Spencer, J. W., Newburn Steel Works, Newburn-on-Tyne ... (E) Feb. 1885

Squire, Charles E., 4, Eden Place, Newcastle Road, Sunderland ... ... ... ... ... ... (E E) { Graduate, Nov. 1893 / Member, Oct. 1898

Staig, William Andrew, Station Road, Wallsend-on-Tyne ... (E) Feb. 1897

Stanley, John T., 70, Falmouth Road, Heaton, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Oct. 1898

Stansfield, George R., 1, Linden Gardens, Harton Village, South Shields ... ... ... ... ... ... ... ... (E) Mar. 1891

Stephen, A. E., Linthouse, Govan, Glasgow ... ... ... (E & S) June 1896

Stephen, John Murray, Linthouse Engine Works, Govan, Glasgow (E) Oct. 1895

Stephens, H. C. J., 94, Fortress Road, Kentish Town, London, N.W. ... .. ... ... ... (E) { Graduate, Oct. 1890 / Member, Nov. 1897

Stephens, Thomas S., 16, Archbold Terrace, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) April 1901

Stephenson, Bernard, 33, Albert Road East, Crosshill, Glasgow (E) Dec. 1896

Stephenson, C., 2. Elm Terrace, The Green, Wallsend-on-Tyne ... (S) Nov. 1884

ELECTED

Stevenson, Robert, Bentham Buildings, The Side, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... ... (E) Oct. 1900
Stevenson, Wm., Bank Chambers, Sandhill, Newcastle-upon-Tyne (E) Nov. 1884
Stewart, James, 13, Otterburn Terrace, Jesmond, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... (E) Oct. 1890
Stirling, Andrew, Jun., 1, Greenvale Terrace, Dumbarton... ... (E) Feb. 1888
Stirzaker, J. C., 16, Grosvenor Place, Newcastle-upon-Tyne ... (E) Nov. 1884
Stoddart, A. Lane, York House, Heworth Village, Felling-on-Tyne, R.S.O. ... ... ... ... ... ... ... (S) Nov. 1898
Stoddart, J. E., Lloyd's Register of Shipping, 71, Fenchurch Street, London, E.C. ... ... ... ... ... ... (E SUR) Oct. 1888
Stoddart, Swinton, 5, Ormonde Street, Sunderland ... (S) { Graduate, May 1885 / Member, Nov. 1892
Stoney, Gerald, c/o Messrs. C. A. Parsons & Co., Turbinia Works, Heaton, Newcastle-upon-Tyne ... ... ... ... ... (E) May 1902
Stuart, John, 57, Heaton Park Road, Newcastle-upon-Tyne (E) { Graduate, Dec. 1895 / Member, Nov. 1901
Stupersky, Antony, Elsdon Terrace, Percy Main ... ... ... (S) May 1901
Summers, James, 4, Vicarage Terrace, Newtown, Stockton-on-Tees ... ... ... ... ... ... ... ... ... (E) Mar. 1889
Surtees, Charles, 4, Cardwell Street, Roker, Sunderland ... ... (S) Dec. 1900
Surtees, R., 22, Alexander Terrace, Gateshead-on-Tyne ... (E) Nov. 1884
Swainston, William, 103, Cardigan Terrace, Heaton, Newcastle-upon-Tyne ... ... ... ... ... ... ... (FM) Nov. 1900
Swan, A. S., Printing Court Buildings, Newcastle-upon-Tyne ... (S) Nov. 1888
Swan, Charles Sheriton, c/o Messrs. C. S. Swan & Hunter, Wallsend-on-Tyne... ... ... ... ... (S) { Graduate, Nov. 1890 / Member, Mar. 1894
Swan, H. F., North Jesmond, Newcastle-upon-Tyne (*Life Member*) (S) Nov. 1884
Swinburne, M. W., 117, Park Road, Newcastle-upon-Tyne ... (E) Nov. 1884
Swinburne, Matthew, Frazer Terrace, Heworth, Felling-on-Tyne ... ... ... ... ... ... ... (S) { Graduate, May 1899 / Member, April 1901
Swinburne, T. M., 18, Bewick Road, Gateshead-on-Tyne ... ... (E) Jan. 1885
Swinney, W., 10, Wentworth Terrace, Westoe Lane, South Shields (E) Dec. 1888
Syme, James, Fairfield Works, Govan, Glasgow ... ... ... (E) Oct. 1892

T.

Tate, Chas. H., 7, Side, Newcastle-upon-Tyne ... ... ... (N A) Nov. 1884
Taylor, Alexander, Maritime Buildings, King Street, Newcastle-upon-Tyne (E) Nov. 1884

ELECTED.

Thompson, Arthur E., 10, Gowan Villas, Jesmond, Newcastle-upon-Tyne .. ... ... ... ... ... ... ... ... (E) May 1898
Thompson, C. E., Thornbeck, Thornhill Park, Sunderland ... ($) Nov. 1884
Thompson, Jas., 2, Carlton Terrace, Sunderland ... ... ... (E) Dec. 1886
Thompson, John Augustus, 9, Billiter Square, London, E.C. (E & N A) Oct. 1892
Thompson, J. L., Westholme Hall, Winston-on-Tees ... ... (S) Nov. 1884
Thompson, Joseph Andrew, Langham Tower, Sunderland ... (S) Nov. 1901
Thompson, Robert Norman, Langham Tower, Sunderland ... (S) Nov. 1901
Thompson, Robert, North Sands Shipyard, Sunderland ... ... (S) Nov. 1884
Thomson, James, M.A., c/o Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., Ordnance Works, Elswick, Newcastle-
Thorn, W. H., 5, Waterville Terrace, North Shields ... ... (E) Nov. 1884
Thornton, James M., c/o Messrs. R. Gordon & Co., Post Office Buildings, Hudson Street, South Shields ... ... ... ... (E) April 1893
Thyne, John Sinclair ... ... ... ... ... ... ... (S) Dec. 1899
Tinn, Fred. D., North View, Mowbray Road, South Shields ... (S) Nov. 1891
Tinn, George, 205, Cardigan Terrace, Gateshead-on-Tyne ... ... (E) Dec. 1897
Tobin, Thos. Charles, 57, Gordon Terrace, Chester Road, Sunderland ... ... ... ... ... ... ... ... ... ... (S) Feb. 1901
Tocher, J. W., c/o Messrs. Wallsend Slipway and Engineering Co., Wallsend-on-Tyne ... ... ... ... ... ... (S) Mar. 1898
Todd, John P., 13, Chatsworth Street, Sunderland ... ... ... (E) Dec. 1897
Todd, George William, 53, Victoria Road, Hebburn-on-Tyne (S) { Graduate, Jan. 1898 / Member, Dec. 1899
Todd, William Surtees, 1, Akenside Hill, Newcastle-upon-Tyne ... (N A) Nov. 1901
Toomer, C. R., Ravensworth, Westoe, South Shields ... ... (E) Jan. 1899
Toovey, Alfred F., Ovington Cottage, Prudhoe, Northumberland (E) Dec. 1894
Tose, Thomas, 30, Thornton Street, West Hartlepool ... ... (E) Mar. 1901
Towers, Edward, Jun., 4, Latimer Street, Tynemouth (E) { Graduate, Nov. 1886 / Member, Oct. 1888
Toyne, G. A. Dryden, Lloyd's Register of Shipping, 3, St. Nicholas' Buildings, Newcastle-upon-Tyne ... ... ...(SUR) April 1899
Trail, John, 21, Grosvenor Place, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... ... ...(M S) Oct. 1892
Traill, Robert, 8, Newcastle Street, North Shields ... ... ... (E) Oct. 1896
Trechmann, J. E., Norton Lodge, Stockton-on-Tees ... ... (E) Feb. 1898
Trewent, F. J., 43, Billiter Buildings, Billiter Street, London, E.C. ... ... ... ... ... ... ... ... .. (S) Dec. 1884
Trowell, Wm. John, Board of Trade Surveyor's Offices, Custom House, Arcade, Liverpool ... ... ... ... ... (E) Oct. 1894
Tsimenis, Andrew, Durham College of Science, Newcastle-upon-Tyne ... ... ... ... ... ... (N A) { Graduate, Oct. 1900 / Member, Jan. 1902
Turnbull, John, 18, Meldon Terrace, Heaton, Newcastle-upon-Tyne (E) Nov 1898
Turner, Charles N., 21, Lansdowne Terrace, Gosforth, Newcastle-upon-Tyne ... ... ... ... ... (E) { Graduate, April 1896 / Member, Dec. 1901
Turner, S. J., 71, Warwick Street, Heaton, Newcastle-upon-Tyne (E) Mar. 1887
Turpie, David Whyte, c/o Messrs. W. Pickersgill & Sons, Southwick, Sunderland ... ... ... ... ... ... ... ... (S) Dec. 1895
Tuxen, Holger, Bureau Veritas Register of Shipping, Heibersgade, 14, Copenhagen, K. ... ... .. ... ... ... (S) Nov. 1896
Twaddell, James L., Green Bank, Jarrow-on-Tyne ... ... ... (S) Oct. 1891

ELECTED.

Tweedy, G. F., 1, Grosvenor Villas, Jesmond, Newcastle-upon-Tyne (E) May 1899
Tweedy, John, Kelso House, Fernwood Road, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Nov. 1884
Tweedy, John, 5, Bellevue Terrace, North Shields ... ... ... (E) April 1899

U.

Ulm, John, The Arsenal, Pola, Austria ... ... ... ... (E) Nov. 1885
Urquhart, Douglas M., 13, Gill Side Grove, Roker, Sunderland ... (S) May 1899

V.

Vardy, George, c/o Messrs. Wigham Richardson & Co., Neptune Works, Newcastle-upon-Tyne ... (E) { Graduate, Oct. 1894 / Member, 1898
Varty, Bartholomew Snowball, Classensgade 26, Stuen Poterbro, Copenhagen ... ... ... ... (S) { Graduate Oct. 1895 / Member May 1901
Vianson, N. E., *vid* Corsica 20/5, Genoa, Italy ... ... ... (E) Dec. 1885
Vick, R. W., Messrs. Furness, Withy & Co., Middleton Shipyard, West Hartlepool ... ... ... ... ... ... ... (S) Nov. 1888
Vowell, Josias, 25, Jackson Street, Sunderland ... ... ... (E) Feb. 1901

W

Wadagaki, Yasuzo, Navy Department, Tokio, Japan ... ... (E) Jan. 1891
Wailes, William C., 23, Richmond Road, Cardiff ... (E) { Graduate, Nov. 1898 / Member, Nov. 1901
Wait, Thomas Herbert, Cail's Buildings, Quayside, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (C E) Dec. 1893
Wake, Tom, 2, Cliff Terrace, Hartlepool ... ... ... ... (E) April 1892
Walker, Archibald, 143, Leith Walk, Leith, N.B. ... ... ... (E) April 1887
Walker, Henry, 11, Oxford Terrace, Gateshead-on-Tyne ... ... (E E) Feb. 1893
Walker, James, c/o Messrs. River Tyne Commissioners' Office, Bewick Street, Newcastle-upon-Tyne ... ... . . ... (C E) Nov. 1898
Walker, John, c/o Messrs. R. Stephenson & Co., Limited, South Street, Newcastle-upon-Tyne ... ... ... ... (E & S) Nov. 1891
Walker, Sept. H., 37, Washington Terrace, North Shields ... (E) Nov. 1899
Wallau, J., 16, Woodhouse Terrace, Gateshead-on-Tyne ... ... (E) Nov. 1884
Waller, Thomas Naunton, 10, Holly Avenue, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) May 1898
Wallis, Robert, Wh.Sc., Point Pleasant House, Wallsend-on-Tyne (E) April 1891

ELECTED.

Watson, Michael, 4, St. Nicholas Buildings, Newcastle-upon-Tyne (C E) Oct. 1900
Watson, Thomas Henry, 10, Neville Street, Newcastle-upon-Tyne (SUR) Jan. 1896
Watts, James Arthur, 16, Westoe Parade, South Shields ... ... (E) Nov. 1900
Watts, Philip, The Admiralty, Whitehall, S.W. ... ... ... (S) Nov. 1885
Wawn, Tom Noel, c/o Messrs. Lloyd's Register of Shipping, Franklinstrasse 30, Dusseldorf, Germany ... ... ...(SUR) Jan. 1900
Webster, William Milne, 23, North View Heaton, Newcastle-upon-Tyne ... ... ... ... ... ... ... (E) Nov. 1900
Weidemann, Nils, Det-Norske Veritas, Christiania, Norway ...(SUR) Jan. 1892
Weighton, R. L., M.A., 2, Park Villas, Gosforth, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Nov. 1884
Weir, George Dobie, Sunderland Engine Works, South Docks, Sunderland ... ... ... ... ... ... ... (E) Oct. 1894
Weir, John, 46, Lawrence Street, Partick, Glasgow ... ... (E) Nov. 1884
Weir, William, 190, Nithsdale Road, Pollokshields, Glasgow ... (E) Nov. 1889
Welton, J. G., 41, Sydenham Terrace, Sunderland .. ... ... (E) Nov. 1893
West, Henry H., British and Foreign Chambers, 5, Castle Street, Liverpool ... ... ... ... ... ... ... (E & N A) Oct. 1886
Westgarth, Tom, Messrs. Richardsons, Westgarth & Co., Middlesbrough ... ... ... ... ... ... ... (E) Oct. 1886
Westmacott, Alfred, Clairvaux, St. Helens, Isle of Wight ... ... ... ... ... ... (E) { Graduate, Dec. 1885 / Member, Nov. 1892
Westmacott, P. G. B., Rose Mount, Sunninghill, Berks ... ... (E) Nov. 1884
Wheater, Chas. Busfield, 73, Rothbury Terrace, Heaton, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E) Oct. 1894
White, A. F., c/o Messrs. Nippon Yusen Kaisha, Tokyo, Japan ... (E) Feb. 1901
White, C., 13, Mosley Street, Newcastle-upon-Tyne ... ... (E) Nov. 1884
White, R. Saxon, Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., Walker Shipyard, Walker-on-Tyne ... ... ... (S) Nov. 1884
Whitfield, Ernest, 11, Victoria Terrace, Low Fell, Gateshead-on-Tyne... ... ... ... ... ... ... ... ... (E) Dec. 1899
Whitfield, Thomas, Messrs. Tyne Dock Engineering Co., South Shields ... ... ... ... ... ... ... ... (E) April 1896
Whittaker, Frederick W., Dockyard, Coburg Dock, Messrs. Mersey Docks and Harbour Board, Liverpool ... ... ... ... (E) Oct. 1892
Whyte, James Anderson, 196, Watt Street, Glasgow ... ... (E) May 1902
Whyte, Wm., Eastrigg, Corbridge-on-Tyne ... ... ... ... (E) Nov. 1884
Widdas, T. D., 56, Plasturton Avenue, Cardiff ... ... (SUR) April 1885
Widdowfield. John H.. 3, Beaconsfield Terrace, Gateshead-on-Tyne (E) Nov. 1901
Wight, Henry D., 7, Holmlands Park, Sunderland ... ... (E E) Dec. 1898
Wildridge, Richard, c/o R. W. Brachead, Bury Street, N. Sydney, N.S.W. ... ... ... .. ... (E) { Graduate, Oct. 1895 / Member, Oct. 1898
Wilkin, Ernest V., 11, Appold Street, Finsbury, London, E.C.... ... ... ... ... ... ... (C E) { Graduate, Nov. 1892 / Member, Oct. 1898
Wilkinson, Thomas, 9, Laburnum Avenue, Wallsend-on-Tyne ... (S) Nov. 1899
Willcox. Henry Walker, 15. Norfolk Street, Sunderland ... ...(C E) Nov. 1897
Willcox, Percy F. C., 15, Norfolk Street, Sunderland ... ...(C E) Nov. 1897
Willcox, R. J. N., 3, The Oaks West, Sunderland ... (E) { Graduate, Mar. 1892 / Member, Dec. 1897
Williams, M. Lucas, 19, Barratt Street, Stockton-on-Tees... ... (E) Nov. 1900
Williams, Thomas, Messrs. South Durham Steel & Iron Co., West Hartlepool ... ... ... ... ... ... (I & S M) Dec. 1900

ELECTED.

Williams, Thomas R., 142, Bede Burn Road, Jarrow-on-Tyne ... (S) Oct. 1895
Williamson, Robt. Tate, 119, Bede Burn Road, Jarrow-on-Tyne ... (E) Oct. 1900
Wilson, B.Sc., Alfred Carruthers, 7, North View, Jarrow-on-Tyne (E) Nov. 1901
Wilson, Edmund, Leazes Park, Newcastle-upon-Tyne ... ... (E) Nov. 1901
Wilson, Henry J. H., 117, Bede Burn Road, Jarrow-on-Tyne ... ... ... ... ... ... ... ... (E) Nov. 1895
Wilson, Henry Maxson, 42, Grosvenor Road, Newcastle-upon-Tyne (E) May 1902
Wilson, James, Messrs. Richardsons, Westgarth & Co., Hartlepool Engine Works, Hartlepool ... ... ... ... ... (E) Jan. 1896
Wilson, John Paul, 123, Osborne Road, Jesmond, Newcastle-on-Tyne (S) Oct. 1895
Wilson, John Reginald, Lyndhurst, Gosforth, Newcastle-upon-Tyne ... ... ... ... ... ... (E E) { Graduate, Mar. 1894 / Member, Dec. 1899
Wilson, William S., 123, Osborne Road, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... (E E) { Graduate, Nov. 1891 / Member, Mar. 1901
Wimble, Arthur, 1, Queen Street, Jersey ... ... ... ... (E) Dec. 1893
Winstanley, P. D., Bureau Veritas Register of Shipping, 155, Fenchurch Street, London ... ... ... ... ... (S) Nov. 1884
Withy, H., Middleton Shipyard, West Hartlepool ... ... ... (S) Nov. 1884
Wood, Henry Alfred, Oakfield Road, North Ormesby, Middlesbrough-on-Tees ... ... ... ... ... ... ... (S) Dec. 1893
Wood, John Scott, 6, Eslington Terrace, Newcastle-upon-Tyne ... ... ... ... ... ... (S) { Graduate, Oct. 1891 / Member, Oct. 1896
Wood, William, 6, Eslington Terrace, Newcastle-upon-Tyne ... (S) Nov. 1897
Woodeson, Wm. A., 13, Richmond Terrace, Gateshead-on-Tyne ... (E) Nov. 1901
Wortley, Henry B., Kent House, Egerton Park, Rock Ferry, Birkenhead... ... ... ... ... ... (S) { Graduate, Jan. 1886 / Member, Nov. 1892
Wotherspoon, James Douglas, 39, Hainton Street, Grimsby ... (E) April 1900
Wray, Thomas W., Board of Trade Offices, Sunderland ... ...(SUR) Jan. 1895
Wright, George H., 23, Albury Park Road, Tynemouth (EE) { Graduate, Feb. 1896 / Member, Dec. 1901
Wright, R., 5, Hawthorn Terrace, Newcastle-upon-Tyne ... ... (E) Nov. 1884
Wynd, William Adam, 8, Dilston Terrace, Gosforth, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (N A) Feb. 1902
Wyse, Thomas. North Lodge, Walker-on-Tyne ... ... ... (E) Nov. 1898

Y.

Young, Andrew, Bureau Veritas, Register of Shipping, 155, Fenchurch Street, London, E.C. ... ... ... (S) { Graduate, Feb. 1892 / Member, May 1893
Young, J. Denholm, 6, Commercial Court, 17, Water Street

ELECTED.

Armstrong, S., Victoria Road, West Hartlepool ... ... ... (A) Nov. 1888
Armstrong, Thomas Henry, Blanchland House, Willington-Quay-on-Tyne ... ... ... ... ... ... .. ... (E A) Nov. 1900
Arnott, James, 25, Dean Street, Newcastle-upon-Tyne ... (S O) Oct. 1895

B.

Barklam, George, Burnt Tree Villa, Tipton, Staffordshire ... (A) April 1888
Barr, John Smith, 16, Broad Chare, Quayside, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... ... (A) Nov. 1893
Barnes, Henry, 43, Otto Terrace West, Sunderland ... ... (A) Nov. 1901
Barwick, J. S., Ashbrook Grange, Sunderland ... ... ... (S O) Nov. 1884
Beynon, Thomas, Hamburg Chambers, Quayside, Newcastle-upon-Tyne ... ... ... ... ... ... ... (E A) Oct. 1891
Bigge, C. W., Northern Counties Club, Newcastle-upon-Tyne ... (A) Dec. 1889
Bingham, Col. J. E., West Lea, Ranmoor, Sheffield... ... ... (M) Mar. 1895
Bird, William, 22, Percy Gardens, Tynemouth ... ... ... (A) May 1896
Borrie, Walter, Messrs. Blair & Co., Ltd., Stockton-on-Tees ... (A) Jan. 1899
Bowmer, John S., 8, Tankerville Terrace, Newcastle-upon-Tyne... (S O) Nov. 1901
Brims, D. N., 4, St. Nicholas' Buildings, Newcastle-upon-Tyne ... (C) Nov. 1893
Brown, Charles Ernest, 1, Ashleigh Villas, East Boldon, near Sunderland ... ... ... ... ... ... ... ... (A) Oct. 1900
Brown, Percy Ledger, 1, St. Nicholas' Buildings, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (E A) Oct. 1896
Brunton, John, 3, Prior's Terrace, Tynemouth ... ... ... (S O) Oct. 1886
Bullen, Tempest C., c/o Messrs. H. E. Moss & Co., K, Exchange Buildings, Newcastle-upon-Tyne ... ... ... ... (S O) Nov. 1891

C.

Carr, Ralph, Thornleigh, Clayton Road, Newcastle-upon-Tyne (A & S O) Nov. 1886
Caws, Frank, 22, Fawcett Street, Sunderland ... ... ... (C E) Oct. 1892
Cay, Arthur, Messrs. Cay, Hall & Co., Exchange, Cardiff ... ... (S O) Nov. 1884
Cohan, Edward Asher, 2, Rumford Place, Liverpool ... ... (S O) Nov. 1889
Cory, John, 14, Mount Stuart Square, Cardiff ... ... ... (S O) June 1896
Coull, John, Baltic Chambers, Quayside, Newcastle-upon-Tyne ... (S O) Oct. 1886
Coverdale, R. H., Messrs. J. Coverdale & Sons, Steamship Owners, West Hartlepool ... ... ... ... ... ... ... ... (S O) Nov. 1888
Crawford, Thomas, 10, Haldane Terrace, West Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... (A) Oct. 1896
Crosier, Edward James, 3, The Hawthorns, East Boldon ... ... (A) Oct. 1889
Culley, F. I., Northumberland Terrace, Tynemouth ... ... (A) Nov. 1899
Culliford, J. H. W., 45, West Sunniside, Sunderland ... ... (S O) Nov. 1884

D.

Dixon, Thomas, c/o Messrs. Sir Raylton Dixon & Co., Ltd., Shipbuilders, Middlesbrough ... ... ... ... ... (A) May 1902
Dodds, E. F., 36, Side, Newcastle-upon-Tyne ... ... ... (A) Nov. 1893
Dodds, John B., 36, Side, Newcastle-upon-Tyne ... ... (CHEM) Oct 1888
Donkin, Geo., Jun., 50, Grove Street, Newcastle-upon-Tyne ... (A) April 1897
Dove, Edward John, 5, St. Nicholas' Buildings, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... ... (M) Oct. 1890
Douglas, John, c/o Messrs. Walker & Hall, 60, Grey Street, Newcastle-upon-Tyne ... ... ... ... ... ... . (A) Oct. 1898

E.

| | | ELECTED. |
|---|---|---|
| Eccles, Edward, Royal Insurance Buildings, Queen Street, Newcastle-upon-Tyne (*Life Associate*) ... ... .. ... | (S O) | Oct. 1887 |
| Evans, Fred. George, 10, Neville Street, Newcastle-upon-Tyne ... | (A) | Nov. 1901 |

F.

| | | |
|---|---|---|
| Fellows, Alfred, Bergholt House, Park Road, Jarrow-on-Tyne | (I & S M) | Nov. 1901 |
| France, James A., St. John Street, Newcastle-upon-Tyne ... | (M) | Jan. 1898 |
| Frazer, Joseph S., Britannia Buildings, Cardiff . ... .. | (M) | June 1896 |
| Furness, Sir Christopher, Baltic Chambers, West Hartlepool . | (S O) | Oct. 1888 |
| Forster, George, 8, Warwick Street, Heaton, Newcastle-upon-Tyne | | Oct. 1898 |

G.

| | | |
|---|---|---|
| Geary, William, Parkside, St. Aidan's Road, South Shields ... | (M S) | May 1899 |
| Gore, Thomas Hoskins, 52, Queen's Square, Bristol ... ... | (S O) | April 1902 |
| Graham, Frank, 21, Groat Market, Newcastle-upon-Tyne ... | (E A) | Nov. 1891 |

H.

| | | |
|---|---|---|
| Hardy, John, Jun., Brunswick Street, West Hartlepool ... ... | (I M) | Nov. 1893 |
| Harland, George, 1, Westoe Crescent, South Shields ... ... | (A) | Dec. 1888 |
| Harris, John T., c/o Messrs. Irvine's Shipbuilding Co., Ltd., West Hartlepool ... ... ... ... ... ... ... | (A) | Mar. 1902 |
| Harrison, Samuel Turner, The Green, Wallsend ... ... ... | (A) | Nov. 1897 |
| Harrison, Thomas, 9, Bridge Street, Sunderland ... ... ... | (A) | Dec. 1894 |
| Hedley, John H., 7, Ashbrook Terrace, Sunderland... ... ... | (S) | Dec. 1886 |
| Hedley, Robert, 3, Summerhill Grove, Newcastle-upon-Tyne ... | (A) | Nov. 1899 |
| Henderson, John T., 5, Logan Terrace, South Shields ... ... | (M) | May 1900 |
| Henzell, Chas. Wright, Royal Insurance Buildings, Newcastle-upon-Tyne .. ... ... ... ... ... ... ... ... | (A) | Nov. 1901 |
| Henzell, Robert, Northern Oil Works, Newcastle-upon-Tyne (*Life Associate*) ... ... ... ... ... ... ... ... | (A) | Nov. 1893 |
| Heslop, Richard O., M.A., Akenside Hill, Newcastle-upon-Tyne | (I & S M) | Oct. 1885 |
| Hinchliffe, John, 25, Hawthorn Street, Newcastle-upon-Tyne ... | (A) | Nov. 1899 |
| Hodges, Thomas Wm., 86, Osborne Road, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... | (A) | Nov. 1899 |
| Hogg, John Thomas, Tyneside Brass Works, Barry Docks, South | | |

[redacted]

J.

| | | ELECTED. |
|---|---|---|
| Jennings, Albert Edward, 4, The Crescent, Gateshead-on-Tyne ... | (M) | Nov. 1901 |
| Jobson, W. J., c/o Messrs. Robert Stephenson & Co., South Street, Newcastle-upon-Tyne ... ... ... ... ... ... | (A) | May 1889 |
| Jordan, John George, 6, Cedars Crescent, Ryhope Road, Sunderland ... ... ... ... ... ... ... ... ... ... | (A) | Nov. 1892 |

K.

| | | |
|---|---|---|
| Kendall, Alfred H., Messrs. Northern Trading Co., Ltd., East Boldon, Newcastle-upon-Tyne ... ... ... ... ... | (M) | Nov. 1901 |
| Knott, James, Prudential Buildings, Newcastle-on-Tyne ... ... | (S O) | Dec. 1896 |

L.

| | | |
|---|---|---|
| Lloyd, John, Deptford Shipyard, Sunderland ... ... ... | (A) | Oct. 1894 |
| Lockie, John, 21, Dean Street, Newcastle-upon-Tyne ... ... | (S O) | Oct. 1892 |
| Lodwidge, Philip, Baltic Chambers, Sunderland ... ... ... | (A) | June 1896 |
| Lord, W. R., 41, Queen's Road, Jesmond, Newcastle-upon-Tyne ... | (M M) | Feb. 1900 |
| Lucock, George, Dean House, Tyne Dock ... ... ... ... | (M) | Oct. 1900 |

M.

| | | |
|---|---|---|
| Macarthy, George E., 54, Pilgrim Street, Newcastle-upon-Tyne ... | (S O) | Oct. 1887 |
| Mail, Douglas B., 3, St. George's Terrace, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... | (M S) | Feb. 1895 |
| Maughan, William, 13, Mosley Street, Newcastle-upon-Tyne ... | (A) | Feb. 1887 |
| McBeath, Harry C., Stromness, Billingham, Stockton-on-Tees ... | (A) | Dec. 1900 |
| McIntosh, R. Y., 34, Dean Street, Newcastle-upon-Tyne ... ... | (E A) | Nov. 1891 |
| MacIntyre, John, 3, Abbotsford Terrace, Newcastle-upon-Tyne ... | (S O) | Jan. 1885 |
| Meek, John George, 13, Belle Vue Park, Sunderland .. ... | (A) | Dec. 1894 |
| Milburn, J. D., Queen Street, Newcastle-upon-Tyne ... ... | (S O) | Nov. 1884 |
| Miller, T. R., 9, Great St. Helen's, London, E.C. ... ... | (A & S O) | Nov. 1884 |
| Mitcalfe, John Stanley, Chairman of Northern Maritime Insurance Co., Maritime Buildings, Newcastle-upon-Tyne ... | (A & S O) | Jan. 1892 |
| Morton, Benjamin, 18, St. George's Square, Sunderland ... ... | (SUP) | Dec. 1895 |
| Moss, J. Frank, Jr., 48, Clifford Road, Sharow, Sheffield ... ... | (S M) | Nov. 1901 |
| Mulherion, G. F., Birtley Avenue, Tynemouth ... ... ... | (A) | Nov. 1884 |
| Muller, J. C. F., 79, Rue Harringrode, Antwerp ... ... ... | (SUR) | Feb. 1890 |
| Murray, Henry H., Hastings Lodge, Hartlepool ... ... ... | (A) | Dec. 1901 |
| Murray, Matthew, The Green, Wallsend-on-Tyne ... ... ... | (A) | Nov. 1893 |

N.

| | | |
|---|---|---|
| Naismith, John, Neptune Works, Newcastle-upon-Tyne ... ... | (A) | Nov. 1901 |
| Nielsen, Hans Christian, 12, Cliff Terrace, Hartlepool ... ... | (S O) | Feb. 1898 |
| Nixon, John, c/o Messrs. Blyth Shipbuilding Co., Blyth ... ... | (A) | Oct. 1894 |

O.

| | | |
|---|---|---|
| Olsen, Hans Benedick, 70, Church Street, West Hartlepool ... | (S O) | Mar. 1893 |

P.

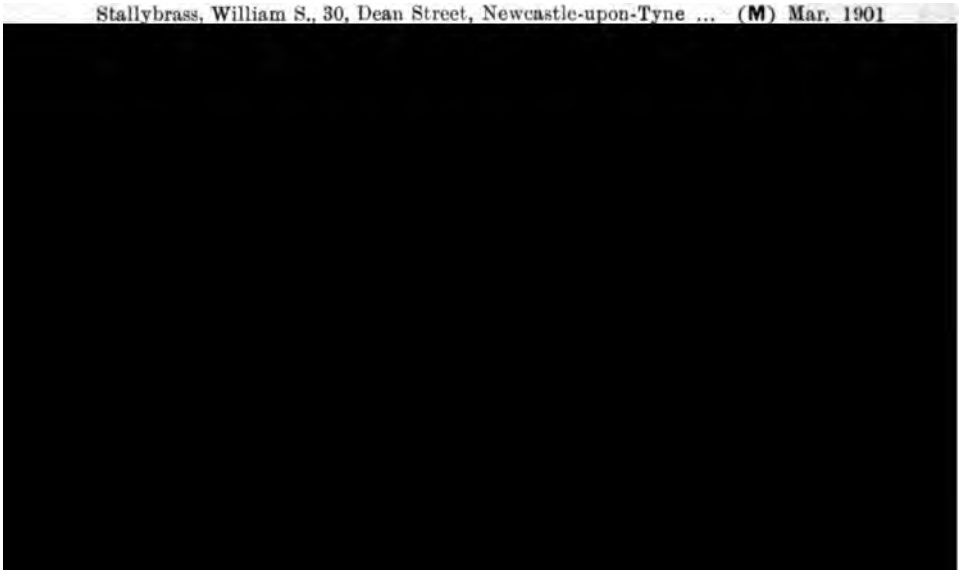
| | | ELECTED. |
|---|---|---|
| Park, Robert, Lauriston, Blackhill, Co. Durham ... ... ... | (A) | Dec. 1897 |
| Parker, George, 62, John Street, Sunderland ... ... ... | (A) | Dec. 1899 |
| Patterson, Thos., 2, The Elms, Sunderland ... ... ... ... | (S) | Jan. 1885 |
| Petersen, William, Messrs. Petersen & Tate, Bank Chambers, Sandhill, Newcastle-upon-Tyne... ... ... ... .... | (S O) | Nov. 1893 |
| Phalp, Oliver, Almora, 37, Richmond Road, Cardiff ... ... | (SUR) | Feb. 1889 |
| Pinkney, Thomas, 3, Ashbrook Terrace, Sunderland ... ... | (S O) | Dec. 1886 |
| Potts, Turnbull, Tyne Docks, South Shields... ... ... ... | (SUR) | Nov. 1898 |
| Pringle, George Frederick, 29, Grainger Street West, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... | (E A) | May 1901 |
| Proctor, J. H., 22, Hawthorn Terrace, Newcastle-upon-Tyne ... | (I M) | Nov. 1893 |
| Purvis, Alexander, Albany Chambers, King Street, South Shields | (M) | Nov. 1901 |
| Pybus, William M., Jun., 85, Osborne Road, Newcastle-upon-Tyne | | April 1899 |

R.

| | | |
|---|---|---|
| Raine, John, Baltic Chambers, Sunderland ... ... ... ... | (S O) | Nov. 1897 |
| Ramsay, J. W., 13, Northbrook Road, Lee, Kent ... ... ... | (A) | Feb. 1885 |
| Ramsay, Norman F., 20, Sanderson Road, Newcastle ... ... | (B F) | Jan. 1902 |
| Reichwald, A., Finsbury Pavement House, Finsbury Pavement, London, E.C. ... ... ... ... ... ... ... | (A) | Nov. 1884 |
| Reid, Sidney, Printer, Akenside Hill, Newcastle-upon-Tyne ... | | Nov. 1884 |
| Renwick, G., M.P., Messrs. Fisher, Renwick & Co., Maritime Buildings, King Street, Newcastle-upon-Tyne ... ... | (S O) | Nov. 1884 |
| Rimer, William Thomas, Craigielea, Low Fell, Gateshead-on-Tyne | (M) | Nov. 1900 |
| Ritson, Arthur, 30, West Sunniside, Sunderland ... ... ... | (S O) | Feb. 1899 |
| Robson, John William, G, King Street, Newcastle-upon-Tyne ... | (M) | April 1896 |
| Rogers, Thomas W., c/o Messrs. Sir C. Furness, Withy & Co., West Hartlepool ... ... ... ... ... ... ... ... | (A) | May 1901 |

S.

| | | |
|---|---|---|
| Scholefield, A., 17, Sandhill, Newcastle-upon-Tyne ... ... | (S O) | Nov. 1884 |
| Scott, W. H., Messrs. Scott Brothers, 46, Sandhill, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... | (S O) | Nov. 1884 |
| Sisson, W. E., 9, Northumberland Terrace, Tynemouth ... ... | (A) | Nov. 1899 |
| Snowdon, W. F., 32, Side, Newcastle-upon-Tyne ... ... ... | (E A) | Dec. 1886 |
| Squance, J. W., 18, The Avenue, Sunderland ... ... ... | (M S) | April 1888 |
| Stallybrass, William S., 30, Dean Street, Newcastle-upon-Tyne ... | (M) | Mar. 1901 |



ELECTED.

Temple, George T., 20, Beach Avenue, Whitley Bay, Northumberland ... ... ... ... ... ... ... ... ... (A) Jan. 1899
Temple, John, Baltic Chambers, Newcastle-upon-Tyne ... (S U R) Mar. 1901
Thompson, John S., 2, Claremont Terrace, Newcastle-upon-Tyne... (A) Nov. 1901
Thompson, Wm. H., 5, Albany Gardens, Whitley Bay, Northumberland .. ... ... ... ... ... ... ... ... (A) Nov. 1899
Thompson, V. T., Baltic Chambers, Sunderland ... ... ...(S O) Dec. 1886
Thorpe, Samuel, Market Place, Chambers 74, High Street, Sheffield ... ... ... ... ... ... ... (I & S M) Feb. 1901
Todd, John Stanley, Percy Park, Tynemouth ... ... ... (U) Nov. 1895
Towers, Edward, 4, Latimer Street, Tynemouth ... ... ... (A) Oct. 1888
Towers, Michael G., Clementhorpe, North Shields ... ... ... (A A) Dec. 1899
Trechmann, Otto K., Church Street, West Hartlepool ... ... (S O) Oct. 1896
Tully, Robert, 9, The Lawe, South Shields ... ... ... ... (M S) May 1900
Turner, Edwin, 32, Powell Road, Clapton, London, N.E. ... ... (A) Oct. 1895

W.

Wainford, Edgar H., Oswald House, Green Lane, Spennymoor ... (A) Nov. 1899
Wallace, H. S. (*Life Associate*) ... ... ... ... ... (S) May 1899
Ward, Heber, Messrs. Walker & Hall, Sheffield ... ... ... (A) Feb. 1901
Wardle, James, 7, Osborne Terrace, Gosforth, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... (M) Nov. 1901
Watson, Thomas W., Gisburn House, Hartlepool ... ... ... (M S) Nov. 1890
Weatheral, Henry, 27, Alderson Street, West Hartlepool ... ... (A) Feb. 1893
Weller, William, 7, Lovaine Terrace, North Shields ... ... (S O) Dec. 1899
Wilkie, John William, Prince's Buildings, Quayside, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... (S O) Oct. 1900
Willis, Thomas W., 143, Stockton Road, West Hartlepool ... ... (S O) Nov. 1899
Wilson, F. Alfred, 45, West Sunniside, Sunderland ... ... (I M) Nov. 1893
Wilson, James, 61, Falmouth Road, Heaton, Newcastle-upon-Tyne (A) Nov. 1901
Winstanley, Robt. Hope, 8, Kenilworth Road, Newcastle-upon-Tyne (A) Nov. 1897
Winter, E. G., 56, Avenue Road, Gateshead-on-Tyne ... ... (A) May 1898

Y.

Yeoman, F., Ship and Steamship Broker, West Hartlepool ... (S O) Nov. 1888
Young, J. A., St. Ann's Rope Works, Newcastle-upon-Tyne ... (R M) May 1901
Young, John Barrow, Optician, 46, Dean Street, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... Nov. 1901
Younger, Robert Laurie, Messrs. Greenock Steamship Co., Limited, Greenock ... ... ... ... ... ... ... ... (A) Feb. 1889

## GRADUATES.

A.

Allan, Percy F., Wansbeck Street, Jarrow-on-Tyne ... ... (E) Nov. 1901
Allen, John C., 20, Mayfair Road, West Jesmond, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... (E) Dec. 1899
Anderson, Thomas C., Bigges Main House, Wallsend-on-Tyne ... (E) Mar. 1902
Andrew, John Davis, 33, Osborne Road, Newcastle-upon-Tyne ... (E) Jan. 1898
Atkinson, Harry, 187, Park Road, Newcastle-upon-Tyne ... ... (E) Nov. 1901
Atkinson, Thomas C., Bigges Main House, Wallsend-on-Tyne ... (E) Dec. 1899

B.

| | | ELECTED. |
|---|---|---|
| Bailey, Ralph U., 3, South Avenue, Ryton-on-Tyne ... ... | (E) | Dec. 1901 |
| Barr, Robert, 40, Oxford Street, Barrow-in-Furness ... ... | (E) | Nov. 1901 |
| Bennett, George H., 15, Osborne Terrace, Gateshead-upon-Tyne ... | (S) | Dec. 1900 |
| Berriman, A. E., 39, West Bank, Scarborough ... ... ... | (E E) | Feb. 1900 |
| Bertram, S. Norman, c/o Messrs. The Lilleshall Co., Ltd., Engine Department, Oakengates, Shropshire ... ... ... ... | (S) | Feb. 1901 |
| Blake, Lionel J. B., Rectory Place, Gateshead-on-Tyne ... ... | | Nov. 1899 |
| Booth, John M. M., Sherburn House, Durham ... ... ... | (E) | Nov. 1901 |
| Bowerbank, Albert William, 52, Victoria Avenue, Whitley Bay, Northumberland ... ... ... ... ... ... ... | (S) | Nov. 1900 |
| Bowmer, Matthew N., 8, Tankerville Terrace, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... | (E) | Dec. 1900 |
| Bullen, Thos. H., 15, Caroline Street, Jarrow ... ... ... ... | | Mar. 1900 |
| Burgess, Norval H., 46, North View, Heaton, Newcastle-upon-Tyne | (S) | Dec. 1901 |
| Burr, Percy B., 16, St. George's Terrace, Newcastle-upon-Tyne ... | (E) | Dec. 1900 |

C.

| | | |
|---|---|---|
| Chicken, George Percy, 17, Kenilworth Road, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... ... | (E) | Dec. 1898 |
| Coaker, William F., 19, Lovaine Crescent, Newcastle-upon-Tyne | (E) | Nov. 1901 |
| Cothay, Frank H., 38, The Avenue, Sunderland ... ... ... | (E) | Feb. 1901 |
| Coulson, Richard H. A., 12, East View, South Shields ... ... | (E) | April 1897 |
| Crookston, David D., 36, Fountayne Road, Stoke Newington, London ... ... ... ... ... ... ... ... | (E) | Nov. 1899 |
| Crow, William George, 45, Rye Hill, Newcastle-upon-Tyne ... | (E) | Nov. 1900 |
| Cruickshank, Andrew, Park Road, Hebburn-on-Tyne ... ... | (E) | Nov. 1899 |
| Currie, Hugh B., 48, Jesmond Road, Newcastle-upon-Tyne ... | (E) | Nov. 1897 |
| Curry, Albert, 68, Rychill, Newcastle-upon-Tyne ... ... ... | (E) | Nov. 1901 |
| Cuttle, Henry H., 93, Coatsworth Road, Gateshead-on-Tyne ... | (E) | Jan. 1902 |

D.

| | | |
|---|---|---|
| Davison, Joseph P., 107, Clumber Street, Newcastle-upon-Tyne ... | (S) | Oct. 1898 |
| Denton, Hugh K., 63, Osborne Road, Newcastle-upon-Tyne ... | (E) | Dec. 1901 |
| Dewar, John, The Green, Wallsend-on-Tyne ... ... ... | (E) | Nov. 1899 |
| Dickinson, Thomas, 38, De Grey Street, Newcastle-upon-Tyne ... | (E) | Nov. 1901 |
| Dilworth-Harrison, D. R., 17, Granville Street, Gateshead-on-Tyne ... ... ... ... ... ... ... ... | (E E) | Nov. 1899 |

| | | ELECTED. |
|---|---|---|
| Fletcher, Arthur C., 58, Hulse Avenue, Tynemouth ... ... | (E) | Mar. 1900 |
| Forster, Charles M., Oakfield, Ryton-on-Tyne ... ... | (E) | Oct. 1898 |
| Fortune, Thomas C., 76, Falmouth Road, Heaton, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... | (E) | Jan. 1902 |

G.

| | | |
|---|---|---|
| Gibbons, Norman B., 15, East Parade, Newcastle-upon-Tyne ... | (E) | Feb. 1901 |
| Gibbs, Alfred Percy, 8, Huntington Place, Tynemouth, Northumberland ... ... ... ... ... ... ... ... | (E) | Nov. 1901 |
| Glahome, John W., 43, North Terrace, Wallsend-on-Tyne... ... | (E) | Nov. 1899 |
| Gray, Robert Bertram, 15, Victoria Villas, W., Newcastle-upon-Tyne | (E) | Oct. 1900 |
| Green, Fred. Wm., 4, Belle Grove Place, Newcastle-upon-Tyne ... | (E) | Jan. 1902 |
| Grey, Alfred Wm., 40, Devonshire Place, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... | (E) | Nov. 1901 |

H.

| | | |
|---|---|---|
| Haig, William G., 1, Humbledon View, Sunderland ... ... | (S) | May 1899 |
| Harvey, Albert G., 17, Beauly Crescent, Tynemouth ... ... | (E) | Nov. 1901 |
| Heck, John S., 10, Bristol Terrace, Newcastle-upon-Tyne ... ... | (E) | Dec. 1899 |
| Heck, William D., 10, Bristol Terrace, Newcastle-upon-Tyne ... | (E) | Jan. 1902 |
| Hedley, Ralph, Jun., 19, Belle Grove Terrace, Newcastle-upon-Tyne | (E E) | Dec. 1899 |
| Holmes, Stephen, 15, Park Road, Jarrow-on-Tyne ... ... | (S) | Dec. 1901 |
| Houston, Cambell, 39, Melville Street, Pollockshields, Glasgow ... | (E) | Nov. 1901 |
| Hudson, William H., 79, Westmorland Road, Newcastle-upon-Tyne | (E) | Nov. 1901 |
| Hutchinson, Wm. G., Rock Lodge, Roker, Sunderland ... ... | (S) | May 1899 |

J.

| | | |
|---|---|---|
| James, Matthew C., Jun., 6, Park Terrace, Gateshead-on-Tyne ... | (E E) | May 1899 |
| James, Wm. E., 6, Park Terrace, Gateshead-on-Tyne ... ... | (S) | May 1899 |
| Jennings, Edward C., 4, The Crescent, Gateshead-on-Tyne ... | (E) | Nov. 1901 |
| Jobling, Vivian, Whickham, Swalwell, R.S.O. ... ... ... | (E) | Oct. 1898 |
| Joicey, Edward James, 30, Bewick Road, Gateshead ... ... | (E) | April 1900 |

K.

| | | |
|---|---|---|
| Knight, Robt. C., Elswick Shipyard, Newcastle-upon-Tyne ... | (S) | Nov. 1901 |

L.

| | | |
|---|---|---|
| Leitch, George A., 4, Akenside Terrace, Newcastle-upon-Tyne ... | (E) | Jan. 1902 |
| Lindsay, James D., Fernville, Gosforth, Newcastle-upon-Tyne ... | (E E) | Jan. 1897 |
| Little, Alvin, 39, Leazes Terrace, Newcastle-upon-Tyne ... ... | (E) | Mar. 1901 |
| Lowrison, Wm. R., Drawing Office, Elswick Shipyard, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... | (S) | Nov. 1901 |
| Lulirs, H., 16, Laburnum Avenue, Wallsend-on-Tyne ... ... | (E) | Nov. 1899 |

M.

| | | |
|---|---|---|
| Milne, George Murray, 18, Kirton Park Terrace, Preston Road, North Shields ... ... ... ... ... ... ... | (S) | Feb. 1898 |
| Morris, David, Haingwood Terrace, Bill Quay-upon-Tyne... ... | (S) | Dec. 1900 |
| Mudd, Percival Arthur, Greencliffe, Hartlepool ... ... ... | (S) | Oct. 1900 |
| Murray, Athole J., Hassendean, Beech Grove, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... | (S) | Nov. 1897 |

N.

| | ELECTED. |
|---|---|
| Neill, John, 15, Salem Hill South, Sunderland ... ... ... | (E) Nov. 1901 |
| Nesfield, Albert C. ... ... ... ... ... ... ... | (E) Nov. 1898 |
| Nesfield, Arthur ... ... ... ... ... ... ... ... | (E) Nov. 1898 |
| Nichol, Robert, 9, Abbey Street, Gateshead-on-Tyne ... ... | (E) Feb. 1902 |
| Nichols, George Henry, 30, Denmark Street, Gateshead-on-Tyne | (E) Oct. 1900 |
| Nixon, John Robert, 4, Bath Terrace, Blyth ... ... ... ... | (E) Feb. 1898 |

O.

| | |
|---|---|
| Owen, Charles E. A., The White House, Old Benwell, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... ... | (S) Nov. 1898 |

P.

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|---|---|
| Posgate, James Stephen, Durham House, Windmill Street, Gravesend, Kent ... ... ... ... ... ... ... ... ... | (E) Nov. 1895 |
| Potts, Arthur W., 9, Beaconsfield Terrace, Gateshead-on-Tyne ... | (E) Oct. 1898 |
| Potts, Joseph, 14, Moreland Street, West Hartlepool ... ... | (E) Feb. 1898 |
| Potts, Herbert Joseph, 42, Grosvenor Place, Jesmond, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... ... | (E) Dec. 1899 |
| Potts, John N., 10, Ashburton Crescent, Gosforth, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... ... | (E) Dec. 1900 |
| Pringle, R. A., 16, Regent Terrace, Newcastle-upon-Tyne ... ... | (E E) Nov. 1901 |

R.

| | |
|---|---|
| Richardson, Norman Shephard, 15, Wentworth Terrace, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... | (E) Mar. 1901 |
| Robinson, Frank Bertie, 10, Dickinson Crescent, Gosforth, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... | (E) Mar. 1899 |
| Robson, Geo., Jun., 9, Wellington Terrace, South Shields ... ... | (E) Mar. 1899 |
| Robson, George, 32, Pollard Street, South Shields ... ... ... | (E) Nov. 1901 |

S.

| | |
|---|---|
| Samson, Robert D. ... ... ... ... ... ... ... ... | (E) Feb. 1902 |

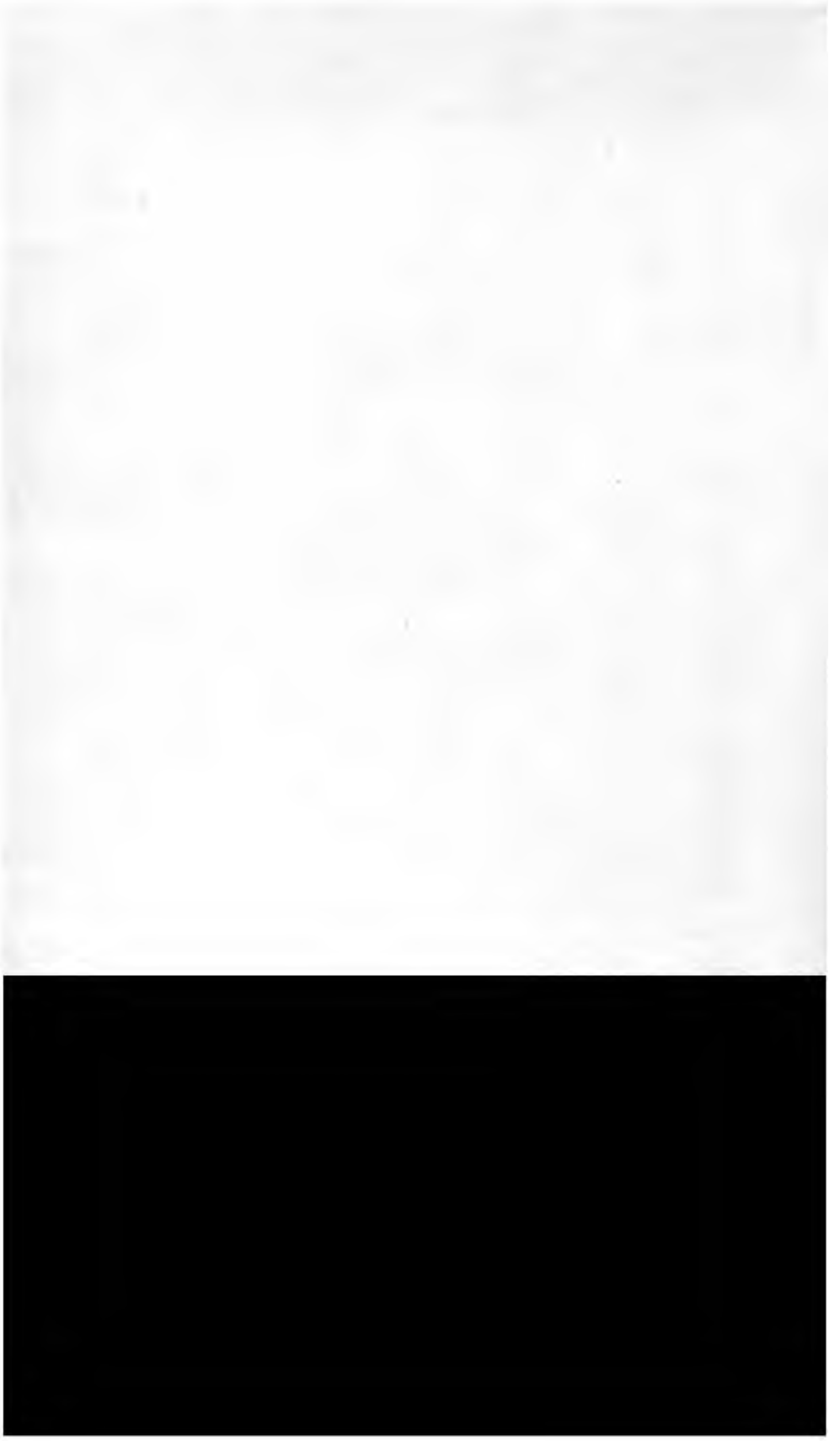
## T.

ELECTED.

Tate, Frank W. ... ... ... ... ... ... ... ... (E) Nov. 1898
Taylor, Arthur T., 26, Rye Hill, Newcastle-upon-Tyne ... ... (S) Dec. 1900
Taylor, John Thomas Lloyd, Dock Engineer's Office, Middleton Road, West Hartlepool ... ... ... ... ... ... (S) Oct. 1900
Temperley, Nicholas R., 4, Carlton Terrace, Low Fell, Gateshead on-Tyne ... ... ... ... ... ... ... ... (E E) Dec. 1898
Thew, Charlton, 80, Osborne Road, Newcastle-upon-Tyne ... (E) Dec. 1899
Thompson, John, 15, Victoria Road, Middlesbrough ... ... (S) Nov. 1899
Thornton, E. Fielding, 5, Catherine Terrace, Gateshead-on-Tyne (E) Dec. 1900
Tulip, Wilfred, Whinney Hill, Choppington, Morpeth, Northumberland ... ... ... ... ... ... ... ... ... (E) Mar. 1902

## W.

Waddingham, W. H., Fernbank, Port Glasgow ... ... ... (E) Nov. 1897
Wardroper, Arthur K., Walker Vicarage, Walker-on-Tyne ... (E) Dec. 1901
Watson, John G. B., 5, Nesham Street, Newcastle-on-Tyne ... (S) Jan. 1902
Watson, Kenneth, 3, Rosella Place, North Shields ... ... ... (E) Mar. 1899
Waymouth, Norman, 32, Roxburgh Place, Heaton, Newcastle-upon-Tyne ... ... ... ... ... ... ... ... ... (E) Nov. 1901
Whyte, Charles, 10, Bellevue Crescent, Tyne Dock, South Shields (E) Nov. 1901
Wilson, William, 117. Bede Burn Road, Jarrow-on-Tyne ... (E) Feb. 1902
Winstanley, P. G., 6, Joannah Street, Newcastle Road, Sunderland ... ... ... ... ... ... ... ... ... (S) Oct. 1898
Wood, Lionel, 4, Simonside Terrace. Heaton, Newcastle-upon-Tyne... ... ... ... ... ... ... ... ... (E E) Nov. 1897
Woods, Arthur, 45, Forsyth Road, Jesmond, Newcastle ... ... (E) Nov. 1900
Wotherspoon, William L. ... ... ... ... ... ... (E) Jan. 1898



NORTH-EAST COAST INSTITUTION

OF

# ENGINEERS AND SHIPBUILDERS.

EIGHTEENTH SESSION, 1901–1902.

## PROCEEDINGS.

The Eighteenth Session of the Institution was opened on the evening of Friday, October 25, 1901, with a conversazione and ball at the invitation of the President (Henry Withy, Esq., J.P.), and Mrs. Withy, in the Assembly Rooms, Westgate Road, Newcastle-upon-Tyne, and was attended by a large assemblage of ladies and gentlemen.

### FIRST GENERAL MEETING OF THE SESSION, HELD IN THE LECTURE HALL OF THE LITERARY AND PHILOSOPHICAL SOCIETY, NEWCASTLE-UPON-TYNE, ON FRIDAY EVENING NOVEMBER 15TH, 1901.

HENRY WITHY, ESQ., J.P., PRESIDENT, IN THE CHAIR.

The SECRETARY read the minutes of the Closing Business Meeting of the Seventeenth Session, held in Newcastle-upon-Tyne on the 17th May, 1901, which were approved by the members present and signed by the President.

The ballot for new members having been taken, the President appointed Messrs. W. G. Spence and R. H. Muir to examine the voting papers, and the following gentlemen were declared elected:—

## MEMBERS.

Baher, Samuel Ernest, Inspecting Engineer, 9, Montross Avenue, Redland, Bristol.

Bladon, Jas. Buckley, Engineer Draughtsman, 12, Havelock Street, Newcastle-upon-Tyne.

Clarke, John Harwood, Marine Engineer, c/o Messrs. Sir Jas. Laing & Sons, Deptford Yard, Sunderland.

Cookson, William D., Engineer, 2, St. Edmund's Road, Gateshead-on-Tyne.

Dalrymple, Alexander, Superintendent, Engineer, 19, Tower Buildings, Water Street, Liverpool.

Dickie, James, Shipbuilder, 35, Brinkburn Terrace, South Shields.

Forrest, Frank, Electrical Engineer, 2, Bath Terrace, Tynemouth.

Fowler, Jas. Speir, Engineer, 14, Renfrew Road, Wallsend-on-Tyne.

Hay, John, Superintendent Engineer, 94, Gower Street, London, W.C.

Hayhurst, James, Civil Engineer, 18, Kenilworth Road, Newcastle-upon-Tyne.

Jack, Fred Barrie, Engineer, c/o Messrs. Worthington Pumping Engine Co., 32, Grainger Street West, Newcastle-upon-Tyne.

Laidler, William, Engineer, c/o Messrs. The Upper Tyne Engineering Co., Skinnerburn Road, Elswick, Newcastle-upon-Tyne.

Lindberg, George, Naval Architect and Civil Engineer, Studsgarden 8, Stockholm.

Lumley, Gascoigne, Superintendent Engineer, 4, Claremont Place, Gateshead-on-Tyne.

Nellist, George, Superintendent Engineer, 2, Burdon Road, Sunderland.

Redpath, David, Engineer, 59, Claremont Road, Seaforth, Liverpool.

Rhodes, Joseph Henry, Engineer, Stonyroyd, Oxbridge Lane, Stockton-on-Tees.

Richardson, John Lyth, Superintendent Engineer, Deddington Chambers, Hull.

Rodgerson, Wm. John, Engineer, 33, Brunswick Street, Gateshead-on-Tyne.

Thackrah, John, Engineer, 43, Ashleigh Grove, West Jesmond, Newcastle-upon-Tyne.

Thompson, Joseph Andrew, Shipbuilder, Langham Tower, Sunderland.

Thompson, Robert Norman, Shipbuilder, Langham Tower, Sunderland.

Todd, William Surtees, Naval Architect, 1, Akenside Hill, Newcastle-upon-Tyne.

Widdowfield, John H., Engineer, 3, Beaconsfield Terrace, Gateshead-on-Tyne.

Wilson, B.Sc., Alfred Carruthers, Engineer, 7, North View, Jarrow-on-Tyne.

Wilson, Edmund, Engineer, Leazes Park, Newcastle-upon-Tyne.

Woodeson, Wm. A., Engineer, 174, Prince Consort Road, Gateshead-on-Tyne.

Henzell, Chas. Wright, Average Adjuster, Royal Insurance Buildings, Newcastle upon-Tyne.

Jennings, Albert Edward, Merchant, 4, The Crescent, Gateshead-on-Tyne.

Kendall, Alfred H., Merchant, c/o Messrs. Northern Trading Co., Ltd., East Boldon, Newcastle-upon-Tyne.

Moss, J. Frank, Jr., Steel Manufacturer, 48, Clifford Road, Sharow, Sheffield.

Naismith, John, Accountant, Neptune Works, Newcastle-upon-Tyne.

Purvis, Alexander, Manufacturer, Albany Chambers, King Street, South Shields.

Swinney, Robt. Nesbit, Accountant, Messrs. Swinney Bros., Ltd., Morpeth, Northumberland.

Thompson, John S., Bank Manager, 2, Claremont Terrace, Newcastle-upon-Tyne.

Wilson, James, Accountant, 61, Falmouth Road, Heaton, Newcastle-upon-Tyne.

Wardle, James, Manufacturer, 17, Balmoral Terrace, Gosforth, Newcastle-upon-Tyne.

Young, John Barrow, Optician, 46, Dean Street, Newcastle-upon-Tyne.

## GRADUATES.

Allan, Percy F., Apprentice Engineer, Wansbeck Street, Jarrow-on-Tyne.

Atkinson, Harry, Apprentice Engineer, 137, Park Road, Newcastle-upon-Tyne.

Barr, Robert, Engineering Draughtsman, 40, Oxford Street, Barrow-on-Furness.

Booth, John M. M., Apprentice Engineer, Sherburn House, Durham.

Coaker, William F., Engineer, 19, Lovaine Crescent, Newcastle-upon-Tyne.

Curry, Albert, Apprentice Engineer, 68, Ryehill, Newcastle-upon-Tyne.

Dickinson, Thos., Apprentice Draughtsman, 38, De Grey Street, Newcastle-upon-Tyne.

Durrant, Aubrey Percy, Apprentice Engineer, 86, Heaton Park Road, Newcastle-upon-Tyne.

Gibbs, Alfred Percy, Apprentice Engineer, 5, Percy Avenue, Cullercoats, Northumberland.

Grey, Alfred Wm., Apprentice Engineer, 40, Devonshire Place, Jesmond, Newcastle-upon-Tyne.

Harvey, Albert G., Apprentice Draughtsman, 17, Beauly Crescent, Tynemouth.

Houston, Cambell, Draughtsman, c/o Miss Edwards, 74, Warrington Road, Newcastle-upon-Tyne.

Hudson, William H., Engineering Draughtsman, 79, Westmorland Road, Newcastle-upon-Tyne.

Jennings, Edward C., Apprentice Engineer, 4, The Crescent, Gateshead-on-Tyne.

Knight, Robt. C., Shipbuilder, Elswick Shipyard, Newcastle-upon-Tyne.

Lowrison, Wm. R., Shipbuilder, Drawing Office, Elswick Shipyard, Newcastle-upon-Tyne.

Neill, John, Apprentice Engineer, 15, Salem Hill South, Sunderland.

Pringle, R. A., Electrical Engineer, Front Street West, Stanley.

Robson, George, Engineer Draughtsman, 32, Pollard Street, South Shields.

Sanders, Harold W., Engineer Draughtsman, 144, Malcolm Street, Heaton, Newcastle-upon-Tyne.

Sinclair, Wm. R., Ship Draughtsman, 1, Stratford Villas, Heaton, Newcastle-upon-Tyne.

Stirzaker, Stanley C., Apprentice Engineer, 16, Grosvenor Place, Newcastle-upon-Tyne.

Waymouth, Norman, Apprentice Engineer, 57, Meldon Terrace, Heaton, Newcastle-upon-Tyne.

Whyte, Charles, Engineer Draughtsman, 10, Bellevue Crescent, Tyne Dock, South Shields.

## VOTE OF THANKS TO THE PRESIDENT AND MRS. WITHY.

Mr. J. R. FOTHERGILL (Vice-President)—The next business on the agenda is one I am sure will appeal to your feelings and to which you will most heartily respond. I have the honour to propose on your behalf as well as my own a hearty vote of thanks to the President and Mrs. Withy for the conversazione they gave and which was so thoroughly enjoyed. Those members who were not able to be present missed a great treat. The hospitality of Mr. and Mrs. Withy, and the graciousness with which they received us all can only be expressed by our highest appreciation, for which I now propose our most cordial thanks.

Mr. R. H. MUIR—I have very much pleasure in seconding the proposal made by Mr. Fothergill, that our heartiest thanks be given to Mr. and Mrs. Withy.

The vote was carried by acclamation.

Mr. FOTHERGILL (to the President)—Sir, on behalf of the members of the Institution, I tender to you and Mrs. Withy our thanks and appreciation for the most gracious and hospitable way in which you entertained us at the opening of the present Session.

The PRESIDENT—Mr. Fothergill, Mr. Muir, and gentlemen, I desire to thank you very much for the kind way in which you have spoken of the conversazione. All I can say is, I hope you enjoyed it as well as we did. It was an exceedingly pleasant evening. It was the first conversazione I have attended, but it

# COUNCIL REPORT.

## (SEVENTEENTH SESSION, 1900-1901.)

The Council has pleasure in stating that the financial position of the Institution is still satisfactory.

The Seventeenth Session of the Institution was opened on Saturday, October 27th, 1900, on which occasion the members were invited to visit the engineering works of Messrs. The Wallsend Slipway and Engineering Co., and the shipbuilding yards of Messrs. C. S. Swan & Hunter, both situated on the river Tyne. Tea was provided for the members on their return to Newcastle-upon-Tyne by the following Tyneside Past-Presidents:—Mr. William Boyd, Mr. Wigham Richardson, Col. Henry F. Swan, and Sir Benjamin C. Browne.

At the meeting held in the evening the President, Mr. Henry Withy, delivered his inaugural address.

During the session the following papers were read and discussed:—

"On the Stress produced in a Connecting Rod by its Motion." By Mr. C. H. Innes, M.A.

"The Ventilating and Heating of Ships by a Forced Circulation of Warm Air." By Mr. F. W. Jennings.

"On some attempts to increase the Efficiency of Marine Boilers." By Mr. G. M. Brown.

"Some Remarks on the Commercial Organisation of Shipyards." By Mr. Walter Scott.

"Water Tube Boilers." By Mr. Edwin Griffith.

"A Simple Method of Preventing the Corrosion of Tail Shafts." By Mr. James M. Thornton.

The engineering gold medal for the sixteenth session was presented to Prof. R. L. Weighton, M.A., for his paper on "The Receiver Drop in Multiple Expansion Engines."

The annual dinner was held in Newcastle-upon-Tyne on Thursday, December 18th, 1900, and was well attended by members and friends.

The great loss which the nation sustained by the death of our late beloved Sovereign Queen Victoria was deeply felt by the members of the Institution and expressed in a dutiful and loyal address of condolence forwarded to His Majesty the King.

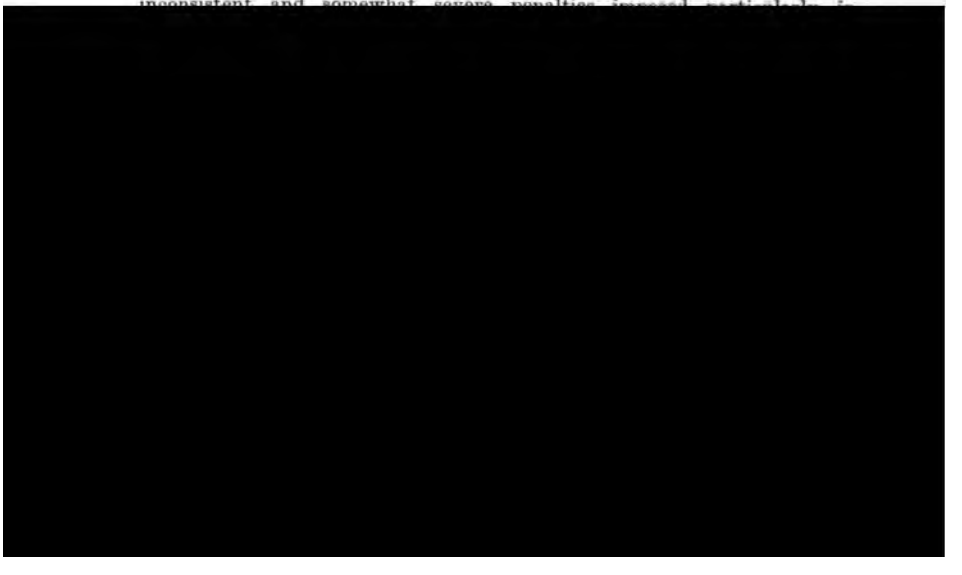
The term of four years for which representatives for the North East Coast District were elected to serve on the Consultative Committee to the Board of Trade having expired, and Mr. John Price and Col. H. F. Swan having expressed their desire to withdraw from the representation, the following gentlemen having been nominated by the Shipbuilders Employers' Association and the North East Coast Engineering Trades Employers' Association to serve on the Committee were duly elected by this Institution, viz.:

*Shipbuilders:*—Mr. Arthur Coote and Mr. G. Jones.
*Engineers:*—Mr. J. H. Irwin and Mr. D. B. Morison.

Prof. R. L. Weighton, M.A., and Mr. G. E. Macarthy were re-elected to represent the Institution on the Sub-Committee of the Northumberland County Council Technical Education Committee.

On the receipt of the new regulations of the Board of Trade relating to the examination of Engineers in the Mercantile Marine a sub-committee was appointed by the Council to consider them and report to the Council. A copy of the following report was forwarded to the Marine Department of the Board of Trade:—

"The Council of the North-East Coast Institution of Engineers and Shipbuilders, by the request of the Board of Trade, have from time to time submitted their opinion relative to regulations for the examination of Marine Engineers, and having recently received from the Board of Trade a copy of the revised regulations, now issued, this Committee recommends the Council to draw the Board of Trade's attention to the apparently



If the Board of Trade consider it, as per Regulation 22 (a), absolutely necessary that three years either as an apprentice or journeyman out of the four years stipulated must be passed in the fitting or erecting shop, or in both, then the extra year or any additional time passed, particularly in any of the departments manufacturing Auxiliary Machinery mentioned in 23 (i) should equally count without any such penalty as referred to in Regulations 28 and 29.

(Signed on behalf of the Sub-Committee),

J. R. FOTHERGILL.

The following reply was received from the Board of Trade:—

Marine Department,
7, Whitehall Gardens, London, S.W.,
21st June, 1901.

SIR,

I am directed by the Board of Trade to thank you for your letter of the 8th inst. calling attention to paragraphs 28 and 29 of the new Regulations relating to the Examination of Engineers, providing that candidates whose workshop service is not performed in fitting and erecting shops where steam engines are made and repaired shall produce evidence of additional engine-room service.

The Board of Trade desire me to state, in reply, that, as at present advised, they do not consider that a case is made out for any further alterations of the Regulations referred to, but the points to which their attention is called shall be noted.

I am, Sir,
Your obedient servant,
(Signed) WALTER J. HOWELL.

Certain alterations have been made in the Rules relating to the awarding of the gold medals, which will be found in the new Bye-Laws. The chief alteration occurs in Rule 5 where it is stated that "Papers read by authors who have already received a gold medal shall not be eligible for a medal till after the expiration of six years from the date of the previous paper for which the medal was awarded."

To meet the convenience of members the times for which the Reading Room and Library were opened have been considerably increased, but the Council regrets to find that the rooms are still very little used.

Professor R. L. Weighton was nominated to represent this Institution at the International Engineering Congress held in Glasgow in the month of September last.

Invitations were received from Messrs. Dorman Long & Co., and Messrs. Bell Brothers for the members of the Institution to visit the Britannia Works and the Clarence Works, Middlesbrough. These were accepted by the President and Council.

The visit took place on May 23, 1901, and was attended by about 200 of the members. The visitors were most kindly and hospitably entertained by the above firms and the inspection of the works proved most interesting and instructive.

The First Lord of the Admiralty having graciously expressed his willingness to receive a deputation of the Members of the House of Commons and representatives of the various Engineering Institutions of the Kingdom with reference to the present unsatisfactory condition of the Engineer Branch of H.M. Navy, the following Memorandum was drawn up and submitted to Sir Fortescue Flannery, M.P., and other members of the House of Commons. The deputation waited upon his Lordship on Tuesday, the 16th day of July, 1901, at the offices of the Admiralty, Spring Gardens, London, W.C. This Institution on that occasion was represented by Mr. Henry Withy, President; Mr. D. B. Morison, Vice-President; and Mr. John Duckitt, Secretary.

His Lordship in reply to the statements and suggestions made, said "All that you have said will be most carefully followed and considered by us."

MEMORANDUM submitted to Sir Fortescue Flannery, M.P., and the Members of the House of Commons constituting the Deputation to the First Lord of the Admiralty, by the North East Coast Institution of Engineers and Shipbuilders, Newcastle-upon-Tyne, the Institute of Marine Engineers (London), and the Institute of Marine Engineers (South Wales Branch), with reference to the present unsatisfactory condition of the Engineer Branch of H.M. Navy.

As the result of careful consideration and full discussion of the accompanying papers by Mr. D. B. Morison, vice-president of the North East Coast Institution of Engineers and Shipbuilders, the above-named Engineering Institutions deem it their duty to record and submit their opinion, that the present constitution and organisation of the Engineer Branch of the Royal

The Engineer Branch being a large and important factor in the war efficiency of the Royal Navy, it would appear that it should be adequately represented on the Board of Admiralty.

In view of the technical nature of the issues involved in Courts Martial affecting the engineering personnel, such Courts should comprise a proportion of Engineer Officers.

The existing system under which Junior Engineer Officers are appointed "in lieu of" Senior Officers, and are thus called upon to undertake the duties and responsibilities properly attaching to the higher rank, without receiving that rank and the corresponding rate of pay, is obviously unjust, and should be suppressed.

The proportion of Engineer Officers of higher rank than Fleet Engineer is at present discouragingly small. We are also of opinion that some attempt should be made to render the Engineer Branch more attractive by a revision of the scales of pay and pension.

In view of the rapid evolution which has taken place during recent years in engineering as applied to naval purposes, we are strongly of opinion that the whole question of the education and training of the engineering personnel should be thoroughly investigated.

The total numbers of the trained personnel of the Engineer Branch at present fall so far short of the requirements of the Service that it is impossible to provide ships in commission with engine room complements which are adequate in numbers, skill, and experience.

Some of the causes above referred to have so far discouraged candidates, that the number of entries into the Engineer Branch through the normal channel has decreased to a dangerous extent, and the Admiralty have had to resort to expedients to make good the deficiency which have lowered the standard of the candidates, and tended to undermine the efficiency of the Branch.

The important duties of the Artificer ratings in modern war-ships can only be efficiently performed by thoroughly skilled and experienced mechanics, such as the existing conditions of service have failed to attract in the required numbers; we, therefore, submit that increased inducements should be offered in respect of pay and accommodation.

Signed—

| | |
|---|---|
| For the North East Coast Institution of Engineers and Shipbuilders. | HENRY WITHY, President.<br>D. B. MORISON, Vice-President.<br>JOHN DUCKITT, Secretary. |
| For the Institute of Marine Engineers, London. | JOHN CORRY, President.<br>JAMES ADAMSON, Hon. Secretary. |
| For the Institute of Marine Engineers, South Wales Branch. | SIR THOMAS MOREL, President.<br>SIR JOHN GUNN, Past-President.<br>THOMAS A. REED. |

*15th July*, 1901.

During the year the following additions have been made to the roll of members:—Members, 73; Associates, 14; Graduates, 28; and 8 Graduates have been passed into the Members section.

The Council regrets having to record the loss by death of the following:—Hon. Member: Lord Armstrong. Members: James Allan, George Arnison, Robert Barnard, George Clark (Vice-

President), Sir Raylton Dixon, Arthur Laing (Vice-President), George Noble, Robert L. Potts, John Renton, Magnus Sandison, John Spear, Joseph Wood. Associates: James Osbourne and Frederick Robson.

The death of Mr. M. Sandison is deeply felt. He joined the Institution shortly after its formation and from the very first took an active part in its affairs. For a number of years he was a member of the Council and has also sat as a member of many of the sub-committees.

The Institution has also lost by resignations and other causes: —41 Members, 4 Associates and 16 Graduates.

The total number of names now enrolled is as follows: —

| | |
|---|---|
| Honorary Members ... ... ... ... ... ... | 3 |
| Life Members ... ... ... ... ... ... ... | 8 |
| Members ... ... ... ... ... ... ... ... | 841 |
| Life Associates ... ... ... ... ... ... ... | 3 |
| Associates ... ... ... ... ... ... ... ... | 139 |
| Graduates ... ... ... ... ... ... ... ... | 119 |
| Total ... ... | 1,113 |

## Graduate Section.

During the twelfth session of the Graduate section eight meetings were held. The average attendance was somewhat less than that of the previous year.

At the opening meeting the Chairman (Mr. H. B. Donaldson) gave his address, the subject being, "The Construction of a Modern Cargo Steamer," and during the session the following papers were read and discussed: —

"The Comparison between English and American Locomotive Practice." By Mr. H. J. Potts.

The thanks of the Institution are due to the principals and officials of these establishments for the kindness and courtesy extended to the junior members.

The following awards were presented to the authors of papers read before this section during the eleventh session:—

Books, etc., to the value of £2 10s. to Mr. Talbot Duckitt for his paper on "Enclosed Electric Motors for Traction."

Instruments, etc., to the value of £2 10s. to Mr. J. S. Posgate for his paper on "Ship Resistances."

Books, etc., to the value of £2 10s. to Mr. B. S. Varty for his paper on "The Transverse Stability of Ships."

Mr. H. B. Donaldson has been re-elected Chairman and Mr. George Nelson Hon. Secretary of this section for the current year.

## NORTH-EAST COAST INSTITUTION OF
## STATEMENT OF RECEIPTS AND PAYMENTS

### Receipts.

| | | £ s. d. | £ s. d. |
|---|---|---|---|
| To Balance from last Account— | | | |
| At Bank ... ... ... ... ... ... ... | | | 206 13 6 |
| „ Subscriptions received for Session 1900-1901— | | | |
| 261 Members at £2 2s. ... ... ... | £548 2 0 | | |
| 554 Members „ £1 1s. ... ... ... | 581 14 0 | | |
| 136 Associates „ £1 1s. ... ... ... | 142 16 0 | | |
| 125 Graduates „ 10s. 6d. ... ... ... | 65 12 6 | | |
| 1076 | | 1,338 4 6 | |
| „ Association of Foremen Engineers and Draughtsmen— | | | |
| One year's Subscription ... ... ... ... ... | | 20 0 0 | |
| „ Subscriptions received in advance ... ... ... ... | | 7 7 0 | |
| „ Arrears from Session 1899-1900— | | | |
| 16 Members at £2 2s. ... ... ... | £33 12 0 | | |
| 29 Members „ £1 1s. ... ... ... | 30 9 0 | | |
| 5 Associates „ £1 1s. ... ... ... | 5 5 0 | | |
| 2 Graduates „ 10s. 6d. ... ... ... | 1 1 0 | | |
| | | 70 7 0 | |
| | | | 1,435 18 6 |
| „ Transactions sold this Session ... ... ... ... | | 32 13 7 | |
| „ Copies of Members' Papers supplied ... ... ... | | 45 19 9 | |
| | | | 78 13 4 |
| „ Tyne Improvement Commissioners— | | | |
| One Year's Interest to 21st June, 1901, on £605, at 3½ per cent. ... ... ... ... ... ... ... | | 21 3 6 | |
| Viz.:—Medal Fund ... ... ... | £274 0 0 | | |
| Graduates' Award and Life Members' Fund ... ... | 331 0 0 | | |
| *Less*—Tax ... ... ... ... ... ... | | 1 1 11 | |
| | | | 20 1 7 |
| One Year's Interest to 10th July, 1901, on £500, at 3¾ per cent. ... ... ... ... ... ... ... | | 18 15 0 | |

[redacted]

# ENGINEERS AND SHIPBUILDERS.

FOR SESSION ENDING 31ST JULY, 1901.

## Payments.

| | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| By Transactions and Papers— | | | | | | |
| Lithographing ... ... ... ... ... ... | 102 | 2 | 3 | | | |
| Printing and Binding ... ... ... ... ... | 209 | 6 | 3 | | | |
| | | | | 311 | 8 | 6 |
| „ Stationery and Circulars ... ... ... ... ... | 106 | 16 | 7 | | | |
| „ Reporting ... ... ... ... ... ... ... | 26 | 2 | 6 | | | |
| „ Rents— | | | | | | |
| Offices and Electric Light Fittings ... ... ... | 112 | 12 | 9 | | | |
| Lecture Rooms ... ... ... ... ... ... | 6 | 14 | 0 | | | |
| Telephone ... ... ... ... ... ... ... | 7 | 8 | 8 | | | |
| | | | | 259 | 14 | 6 |
| „ Rates, Gas, Electric Light, and Insurance... ... ... | | | | 30 | 0 | 7 |
| „ Salaries— | | | | | | |
| Secretary, Salary ... ... ... ... ... ... | 340 | 0 | 0 | | | |
| „ Commission ... .. ... ... ... | 70 | 15 | 11 | | | |
| Assistants' ... ... ... ... ... ... ... | 25 | 7 | 0 | | | |
| „ Postages, Stamps, Post Cards, Parcels, etc. ... ... | 115 | 12 | 1 | | | |
| „ Secretary's and Office Expenses, Coal, Cleaning, etc. ... | 86 | 14 | 6 | | | |
| „ Painting and Decorating Rooms ... ... ... ... | 25 | 19 | 4 | | | |
| „ Measured Mile Posts—Rent... ... ... ... ... | 6 | 6 | 0 | | | |
| „ Auditor's Fee ... ... ... ... ... ... ... | 5 | 5 | 0 | | | |
| „ Lantern Expenses ... ... ... ... ... ... | 3 | 0 | 0 | | | |
| | | | | 678 | 19 | 10 |
| „ Library Account— | | | | | | |
| New Books ... ... ... .. ... ... ... | 14 | 8 | 4 | | | |
| Bookbinding ... ... ... ... ... ... | 4 | 7 | 8 | | | |
| | | | | 18 | 16 | 0 |
| „ Furniture Account— | | | | | | |
| Alteration to Bookcase, etc. ... ... ... ... | 16 | 8 | 3 | | | |
| Portraits ... ... ... ... ... ... ... | 8 | 10 | 6 | | | |
| | | | | 24 | 18 | 9 |
| Gold Medals' Fund— | | | | | | |
| Gold Medal awarded ... ... ... ... ... | | | | 5 | 10 | 0 |
| „ Graduates' Award Fund— | | | | | | |
| Amounts awarded for Papers ... ... ... ... | | | | 7 | 10 | 0 |
| „ Balance at Bank ... ... ... ... ... ... | | | | 449 | 5 | 0 |
| | | | | £1,786 | 3 | 2 |

## BALANCE SHEET FOR SESSION ENDING 31ST JULY, 1901.

| | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| 5 6 | | | | | | |
| 2 8 | | | | | | |
| | 304 | 8 | 2 | | | |
| ... | 5 | 10 | 0 | | | |
| | | | | 298 | 18 | 2 |
| 6 1 | | | | | | |
| 3 5 | | | | | | |
| | 230 | 9 | 6 | | | |
| ... | 7 | 10 | 0 | | | |
| | | | | 222 | 19 | 6 |
| ... | | | | 231 | 0 | 0 |
| ... | | | | 7 | 7 | 0 |
| ... | | | | 2,411 | 16 | 8 |

ified,
. SISSON, F.C.A.

### Assets.

| | | | | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|---|---|---|
| Subscriptions in Arrear— | | | | | | | | | |
| Session 1899-1900 ... ... ... ... | | | | 1 | 1 | 0 | | | |
| „ 1900-1901 ... ... ... ... | | | | 55 | 2 | 6 | | | |
| | | | | | | | 56 | 3 | 6 |
| Stock of Transactions, valued at ... ... | | | | | | | 189 | 5 | 3 |
| Office and Library Furniture, Safe, etc., as at 31st July, 1900 | | | £121 | 14 | 10 | | | | |
| Additions ... ... ... | | | 24 | 18 | 9 | | | | |
| | | | | | | 146 | 13 | 7 | |
| *Less*—Depreciation ... ... ... | | | | | | 12 | 3 | 6 | |
| | | | | | | | 134 | 10 | 1 |
| Books in Library— | | | | | | | | | |
| As at 31st July, 1900 ... | | | £326 | 1 | 2 | | | | |
| *Less*—Depreciation ... | | | 32 | 12 | 0 | | | | |
| | | | | | | 293 | 9 | 2 | |
| Additions this Session— | | | | | | | | | |
| Books received in exchange for Transactions ... ... | | | £30 | 0 | 0 | | | | |
| Purchases ... ... ... | | | 14 | 8 | 4 | | | | |
| | | | | | | 44 | 8 | 4 | |
| | | | | | | | 337 | 17 | 6 |
| Tyne Improvement Commissioners—Investment in respect of the following Accounts, viz.:— | | | | | | | | | |
| Gold Medals' Fund ... ... ... ... | | | | | | 274 | 0 | 0 | |
| Graduates' Award and Fund Payments by Life Members and Associates ... ... | | | | | | 331 | 0 | 0 | |
| General Capital— | | | | | | | | | |
| As at 31st July, 1900 ... ... | | | | | | 1,400 | 0 | 0 | |
| | | | | | | | 2,005 | 0 | 0 |
| Cash—At Bank ... ... ... ... | | | | | | | 449 | 5 | 0 |

The PRESIDENT—I beg to move that the Report of the Council and the Financial Statement be adopted.

Mr. J. R. FOTHERGILL—As a member of the Finance Committee I beg to second the resolution. I think the balance sheet will appeal to you as a very satisfactory one. We have, according to the balance sheet, £1,400 invested, but to this should be added £115. If you look at the receipts from the Graduates Award and Life Members' Fund, where we have £331, which includes about £115 from the Members' Life Fund, etc., this sum should be added to the amount invested, bringing it up to £1,515 invested, from which we derive an income of £44 17s. per annum. We have £449 balance at the bank and £300 of this has also been invested, making a total investment of £1,815, exclusive of the Gold Medals and Graduates' Awards funds. I think you will agree that that is very satisfactory indeed. But, if you turn to the assets, you will there find we are in the unfortunate position to which I have referred on previous occasions. It is not by any means a pleasant duty to have to refer to it, but it is only right to bring into prominent notice the arrears of subscriptions. We have had to write off £21 10s. 6d. arrears irreclaimable and have carried forward £56 3s. 6d. amount of subscriptions for last year still unpaid, but which we have hopes of obtaining. It almost seems incredible that this should take place, but it does year after year. It is in my memory that last year more than this was written off. It is a sorry picture, but I suppose we shall have to continue to do it year by year. Otherwise, the balance is very satisfactory; indeed, you will see that the Committee has taken the proper precaution of writing down their office and library furniture, which I am sure you will agree is a proper and business thing to do.

There being no further remarks, the President put the reports to the meeting, and they were accepted *nem. con.*

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The PRESIDENT delivered his opening remarks.

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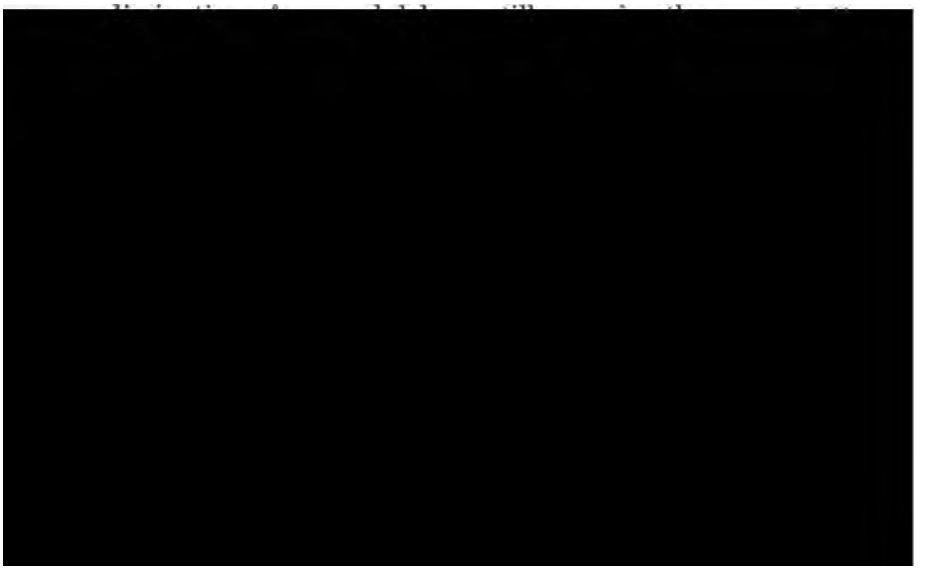
Mr. J. W. LITTLEDALE read a paper on "The Speed of Machine Shop Tools."

## PRESIDENT'S OPENING REMARKS.

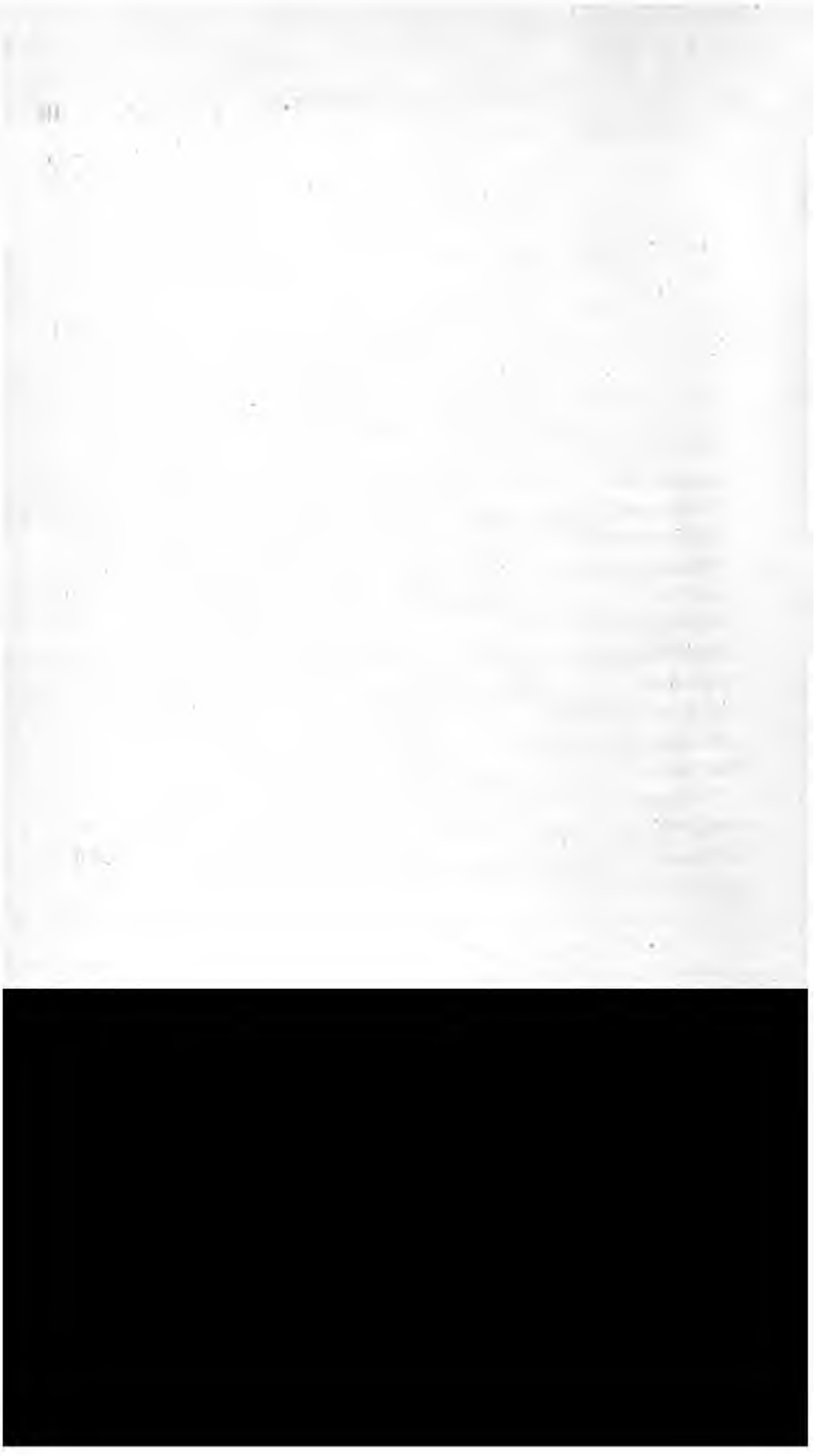
The PRESIDENT—Gentlemen, I am told that it is usual, at the first meeting of the second Session, for the President to make a few opening remarks. In the first place I cannot but thank the members of Council and the members of the Institution for their very great courtesy, kindness and forbearance during the past Session. The support and assistance I have had from every one has rendered my duties exceedingly pleasant. I may say that I consider the report which the Council has submitted to you to-night a very satisfactory one. I do not need to go into details, the main point is that the membership has increased by 54 in the year, and to judge from the long list of new members passed to-night, it looks as if the roll would go on increasing, as I sincerely hope it will. Naturally, in making a few remarks, I am indebted to the report of the Council, as we must necessarily refer to the same subjects. We are mourning the death of Her Most Gracious Majesty Queen Victoria. We sent to the King a dutiful memorial at the proper time. The death-roll amongst our members is exceedingly heavy, including such distinguished names as Lord Armstrong, Sir Raylton Dixon, Mr. George Clark, Mr. Arthur Laing, and Mr. M. Sandison, the latter gentleman coming to a most untimely end in the ill-fated "Cobra," Mr. Osbourne, Mr. Arnison and others. During the year, a most able scholar has been removed from our midst in the person of the Lord Bishop of Durham. The Council has referred to the alterations in the rules regarding the gold medals. I may say the Council had a good deal of discussion over these matters, and it was felt that the alteration would give more encouragement to the younger members. Then the hours during which the reading room and library are open have been considerably extended, but, from what I can gather, members do not make as much use of the library as they might do, and I must urge all, and especially the younger members, to take full advantage of the books available for reference, and of the other means of education. We have had two excursions—very pleasant excursions—to Sheffield and Middles-

bro'; we visited the works of Messrs. Walker & Hall, Messrs. Thos. Firth & Sons, Messrs. Seebohm & Dieckstahl of Sheffield; and on the occasion of our visit to Middlesbro' we inspected the works of Messrs. Dorman, Long & Company, and Messrs. Bell Bros., and I am quite sure the best thanks of the Institution are due to these firms for their kindness. I believe our thanks have already been forwarded officially. We had an interesting paper from Mr. D. B. Morison, one of our vice-presidents, respecting the status and position of naval engineers. I may say that a deputation of members of Parliament—along with certain representatives of societies such as our own, with whom the Secretary, Mr. Morison and myself were present—waited upon the First Lord of the Admiralty and urged the petition of which you have already seen copies. We do not know that any good result has arisen; but we know that the Admiralty are making very full inquiries, and we have reason to hope that some good result will be achieved in the future. Although the shipbuilding business is at present fairly brisk, there are practically no inquiries in the market. This of course is accounted for by the very depressed condition of the freight market, and I am sorry to say that at present the outlook is not at all reassuring. In fact, I am quite convinced that we are on the brink of a very serious depression, and it behoves us all, engineers, shipbuilders and workmen to do all in our power to minimise the cost of production, so that the works may be kept partially, if not wholly in operation. I am pleased to say that the relations between masters and men during the past 12 months have been of the most cordial description, there having been practically no strikes or disputes of any magnitude. The



makers. Messrs. R. Stephenson & Company's new shipyard at Hebburn is making satisfactory progress, the sheds being now complete, most of the machinery in place, and a temporary power-house erected. The Government is at present paying special attention to the coaling of war vessels and the storage of coal for this purpose. On the north-east coast we have recently had two great amalgamations; firstly, that of the West Hartlepool Steel & Iron Company, the South Durham Steel & Iron Company and the Moor Iron Works, in the steel trade; and in the engineering trade that of Messrs. T. Richardson & Sons, Limited, Hartlepool; Messrs. Sir Christopher Furness, Westgarth & Company, Limited, Middlesbrough; and Messrs. W. Allan & Company, Limited, Sunderland. It is hoped that by more central management these concerns will be able to cheapen the cost of production, with benefit to both employer and employed. It is to be regretted that the iron works at Tudhoe cannot be carried on profitably, but the position of the works is against economical production. Few of us expected they would be closed and I do not imagine that the directors of this Company will quietly submit to the loss of their plate trade, but will try to put matters right, so that they may be enabled to continue the manufacture of boiler plates and add the manufacture of ship plates. With due economy, success should crown such an effort.

I know you will be glad to get on with the other business of to-night's meeting, so I will content myself with thanking you for your very great kindness during the past Session.



# THE SPEED OF MACHINE SHOP TOOLS.

By J. W. E. LITTLEDALE.

[Read before the Institution in Newcastle-upon-Tyne, on November 15th, 1901.]

Of the many and varied methods of increasing their output adopted in engineering works to keep pace with the times, not the least powerful one is the working of their machine shops to their utmost possible capacity. Of recent years the machine shop has become the most vital artery of all engineering projects, and it has struck me as peculiar how loth young engineers sometimes are to go through the machine departments when learning their trade, and when induced to start in a machine shop how amazingly soon they get tired of it. Also what little notice is taken of the practical working of machines in technical colleges as a rule. To get anything like a satisfactory interest on the capital expended in paying machine-men and cost of running machines, a works must have a number of automatic machines worked by a single hand, a monopoly on the product, or the existing machinery worked up to its full bore. I intend in this short paper to take an average machine shop for general engineering work, and shall not touch on the wide field of special machinery, such as rolling mills, machines for rifling and boring large guns or small arms, and machines for the automatic manufacture of small parts of armament, etc.

Machine tool-makers of late have improved their manufactures to such an extent that the average works' manager views with feelings of apprehension the rows of out-of-date tools with which he has to try to compete against foreign competition; he would like to clear out the most of them and replace with those of new design. That is an expensive amusement to indulge in to any large extent, but in such a case matters can be greatly improved (1) by putting in a few new first-class machine tools, specially

adapted for not only the work he has in hand, but ample in size and design to cope with future prospects of a larger class of work; (2) by running his existing plant full capacity. On going through the works of modern machine tool-makers, one notices improvements which in some cases are startling revelations—in others are revelations, but not startling—and often make the visitor ask himself: Now why don't they do that on old-fashioned machines? or a query to that effect. Some of the difficulties to be met with in endeavouring to adopt modifications of modern methods on existing plant are as follows:—

(1) The want of stiffness in some of our old type machines to stand a high rate of speed and heavy feed.
(2) The want of accommodation for fixing either travelling rests or steadying rests.
(3) The great variation of ratios between the steps of the speed cones.
(4) The slipping of the belt.
(5) The cutting tool becoming blunt and useless.
(6) The man who works the machine.

Taking the difficulty of the want of stiffness in a machine to do what you consider it should do, one cannot very well patch it up and make it stronger; and scrapping it is as a rule advocated. But one can assist matters to a certain extent by reducing the feed, or depth of cut, and if it does not happen to be a planing machine with one speed, increase the speed of the machine considerably, which, by using a sample of specially treated tool steel, one can do with success. If it does happen to be a machine of the above

we get an improvement in the steadiness of the job; also by seeing that the lubricant reaches that part of the cutting tool where it is required. You will notice, in such a case, that the tool that is inverted, and has the lubricant dripping on to its point, will last longer than the one on the side that has the water dropping on to the shaving of material and dribbling uselessly down the side. Dirty water dabbed on with a stick or rag is what an old-fashioned lathe gets as a rule, but the modern machine, with all its fine automatic gear and equipment shining, must have a high-class sample of oil and we make comparisons between them, the one with every possible chance to do its work well, the other to take its chance. This inefficient means of applying a lubricant to a cutting tool can be remedied in two ways; one a good one, the other a makeshift. The good one is by having your shop fitted with a system of high-pressure mains, leading the mixture you think fit to use up to your machines, as one would a gas service, or a pump working on each machine. The makeshift is to turn up the spout of the can, and have the can fixed up a height and get a head; one can get a fairly good jet of lubricant on to the proper part of the cutting tool in this way. We can adopt the plan of two cutting tools diametrically opposite on a chuck lathe of any size and this plan steadies the job. When we have to turn a job with a break in the cut, and of considerable length, one cannot with satisfaction adopt a high rate of speed in cutting or a heavy feed, unless we can provide an efficient means of keeping the work steady by a rest as near to the weakest point in the job as possible.

The variation in the speed ratios on the cones very often gives trouble. I have often spoken to a man for running his machine too slow, and the excuse was that the next speed was too fast; and usually it was, owing to the immense difference in the ratios of the speeds. With, for instance, the fastest speed on with the back gear in and changing to the slowest direct driving we get a tremendous difference of speed. This cannot very well be remedied with existing plant, if we are driving off the main shop shafting, which will be running at a speed most suitable for the majority of the machines driven by it; but if, as mentioned before, you happen to have an electric motor of ample capacity to take the maximum load of the machine tool, and equipped with the necessary adjustable resistances, etc., we can often in this case

get an intermediate speed between the steps of the driving cone. It is a point I consider to be regarded with much favour in selecting a new machine tool—its range of speeds. If machine tool-makers would keep the ratio between any two successive speeds not greater than 4—3 and they should be constant, we could get a fairly good succession of speeds, but we should require a large number of steps on the cones, to embrace a wide range of diameters of turning work. This latter case is not of much account, as with the exception of sparsely equipped works the sizes of jobs do not vary considerably for one machine.

To work machine shop tools at a high productive rate, we often encounter the trouble of getting the belts to take a proper grip of the cones; this is due in some cases to the short drive available, the want of sufficient width, or the excessive amount of camber or radius put on the cones: this in many cases reduces the amount of adhesive portion of the belt. The higher the belt speed, the less likelihood of slipping when an excessive strain is put on. It is stated on good authority that the stress in a belt should not exceed 45 lbs. per inch of width. A lathe for ordinary shop work absorbs about one horse-power, so that its speed in feet per minute ought to be at least $\frac{33,000}{45 \times \text{width}}$. Thus a 3 inch belt, when on the countershaft pulley, runs at not less than 250 feet per minute.

The difficulty of the cutting tool becoming blunt: the point wears off, gets glazed or softened by excessive heating, and will not cut. We can help the lasting qualities of the tools in some extent, by attending to the matter of lubrication afore-mentioned, even when turning cast iron, although that is not a general practice, I have found it useful. Also by having the tools supplied

The following table and sketch give an example of a reliable machine cutting tool designed to stand a high rate of cutting speed with heavy feed, and has been adopted to attain as nearly as possible these ends; the angle for Y should be such as to give a clean cut and afford the least resistance to the rotating job; the angle of clearance or X should be as small as possible, to assist in keeping up the strength of the point of the cutting tool. In practice, I have usually made the angle Z less acute than is advised by writers on this subject. The angle O should be the same as X, and kept small.

For Cast Iron.

| | | | |
|---|---|---|---|
| Angle of | X | 3 | degrees. |
| ,, | Y | 70 | ,, |
| ,, | Z | 15 | ,, |
| ,, | O | 3 | ,, |

For Steel, Wrought.

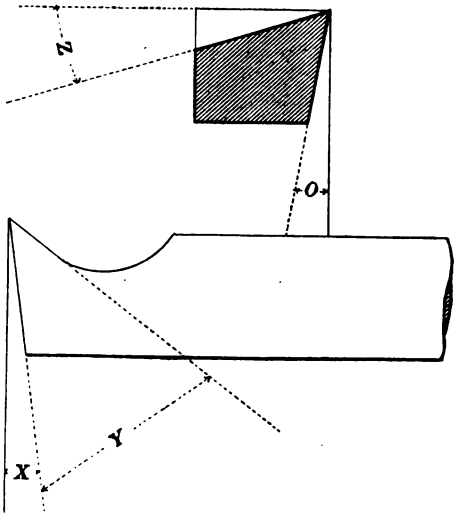
| | | | |
|---|---|---|---|
| Angle of | X | 3 | degrees. |
| ,, | Y | 60 | ,, |
| ,, | Z | 20 | ,, |
| ,, | O | 3 | ,, |

For Brass.

| | | | |
|---|---|---|---|
| Angle of | X | 3 | degrees. |
| ,, | Y | 80 | ,, |
| ,, | Z | 15 | ,, |
| ,, | O | 3 | ,, |

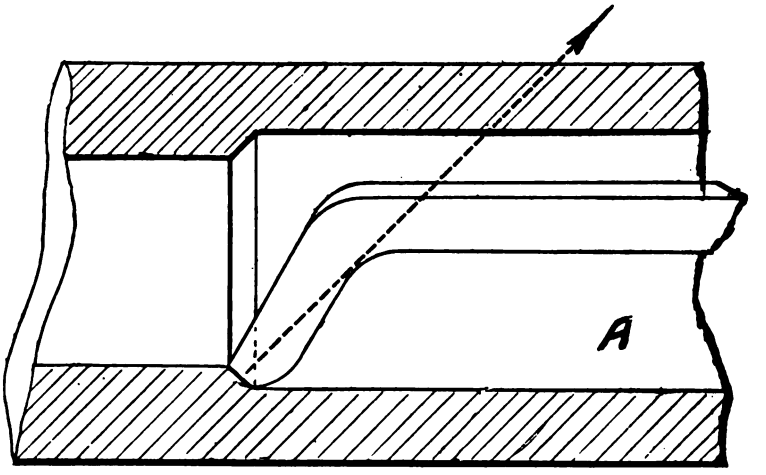
For Wrought Iron.

| | | | |
|---|---|---|---|
| Angle of | X | 3 | degrees. |
| ,, | Y | 56 | ,, |
| ,, | Z | 20 | ,, |
| ,, | O | 3 | ,, |

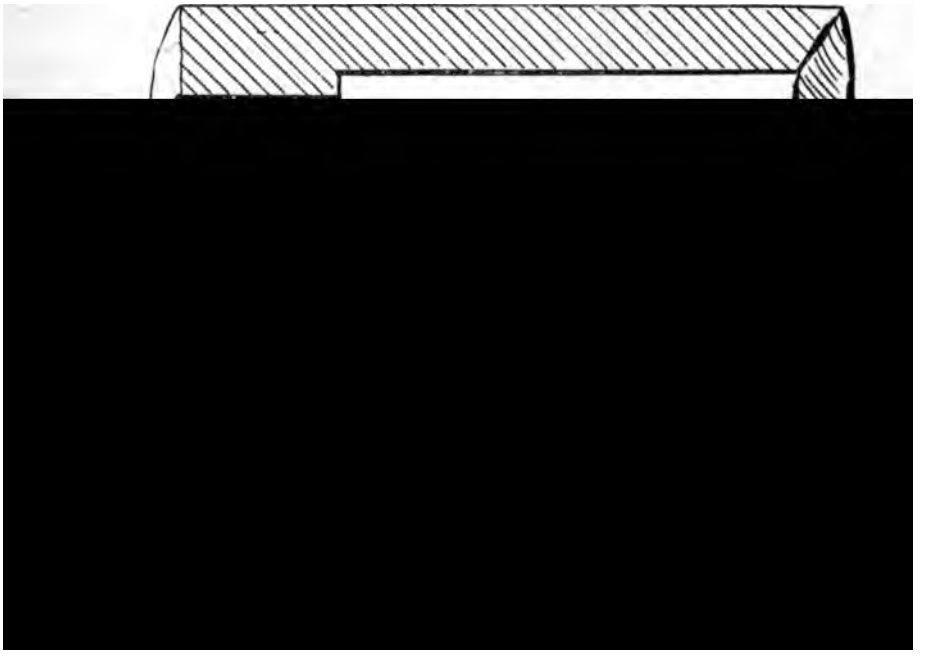


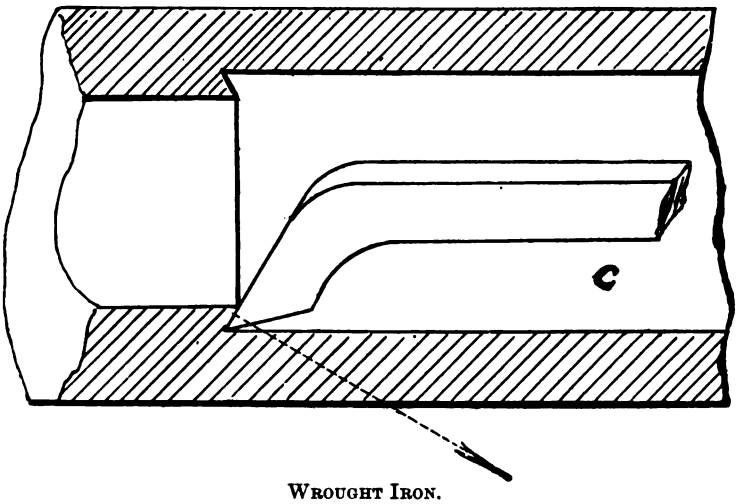

To get a good result with boring for lathe work tools great attention should be paid to their shape, for, as a rule, the tool has to project so far from the rest that a badly-formed tool will give considerable amount of trouble in a long job; and the hole or cylinder will be tapered. It is obvious that if the hole to be bored out is a long one, and the material hard, we cannot maintain a heavy cut, or high speed without loosing the cutting edge of the tool and doing bad work. If we can get in a stout and rigid tool bar, keeping the cutting tool as short as possible, and use a high-quality steel, we shall get far better results. In the case, however, of a boring tool, the distance of the cutting edge from the

tool bar rest renders the slightest variation in the efficiency of the cutting edge enough to materially affect the work. We can see this if we bore out a hole half of its length, and then, merely pressing on the body of the tool or tool holder with the fingers, this is sufficient to cause a difference in the diameter of the hole. On referring to the following sketches, I give a few instances of the material differences in the shape of a tool and its efficiency to do good work at a reasonable speed.




BRASS.






WROUGHT IRON.

The pressure on the cutting edge acts in two directions; one vertical the other lateral. The downward pressure is always there and cannot be altered with the shape of the tool, but the lateral pressure varies according to the direction of the plane of the cutting edge of the tool to the direction in which the tool travels; the pressure in the above, indicated by arrows, being at a right angle to the plane of the cutting edge. A would leave the cut as it became blunt, or the length would cause it to spring; B would not spring away or in to the cut, but would require more pressure to keep it cutting; whilst C would run right in. I have written over these tools the metals that they would work best in.

If when working with milling cutters we encounter a tough piece of metal, or one with a chilled skin, we can help the cutting tool to maintain its sharpness, by feeding the metal to the milling cutter so that the teeth meet and cut underneath the skin, and not down on to the top of it, which would in such a case take the edges off the cutter very soon.

To arrive at the crux of machine shop success, *i.e.*, that of removing the largest amount of superfluous metal, and reaching accurately a given dimension in the shortest possible time—if our machines are average good ones and we can obtain acceleration of our driving speed—one must have a good sample of steel that will stand a high rate of speed and heavy feeds and cuts. The proper speed at which to run a machine is the highest it will stand with-

out springing the job, or causing the belt to slip badly, or even break.

The following tables give speeds of machine tools in general practice, which I have used with good results, using the ordinary steel and mushet for the highest speeds: —

TABLE OF CUTTING SPEEDS. — FOR STEEL.

| Diameter of Work. | Roughing Cut. | | Finishing Cut. | |
|---|---|---|---|---|
| | Speed in feet per minute. | Revolutions to feed tool 1 inch. | Speed in feet per minute. | Revolutions to feed tool 1 inch. |
| 1 in. and less | 20 | 25 | 20 | 30 |
| 1 in. to 2 in. | 18 | 25 | 18 | 30 |
| 2 in. to 3 in. | 18 | 25 | 15 | 30 |
| 3 in. to 6 in. | 15 | 20 | 15 | 30 |
| FOR WROUGHT IRON. | | | | |
| 1 in. and less | 35 | 25 | 38 | 30 |
| 1 in. to 2 in. | 25 | 20 | 30 | 30 |
| 2 in. to 4 in. | 25 | 20 | 25 | 25 |
| 6 in. to 12 in. | 20 | 15 | 23 | 20 |
| 12 in. to 20 in. | 18 | 12 | 18 | 16 |
| FOR CAST IRON. | | | | |
| 1 in. and less | 38 | 20 | 38 | 20 |
| 1 in. to 2 in. | 35 | 20 | 35 | 16 |
| 2 in. to 4 in. | 30 | 20 | 30 | 10 |
| 4 in. to 6 in. | 25 | 15 | 25 | 6 |
| 6 in. to 12 in. | 20 | 14 | 20 | 6 |
| 12 in. to 20 in. | 20 | 10 | 20 | 4 |
| FOR BRASS. | | | | |
| 1 in. and less | 120 | 25 | 120 | 25 |
| 1 in. to 2 in. | 100 | 25 | 100 | 25 |
| 2 in. to 4 in. | 80 | 25 | 100 | 25 |

worked out curves for feeds and speeds and there is nothing like a good curve to place before anyone, to grasp a subject quickly. These curves are in most cases taken out in inches.

The possibilities of a high rate of feed and speed with strong machines of a modern type, and specially treated steel tools were clearly demonstrated at the Paris Exhibition; and the company that gave the best show of high-speed cutting was the Bethlehem Steel Company. There is a paragraph in *Engineering* of August 17th, 1900, which states: "The American technical journals report that some remarkable results have recently been obtained in increasing the endurance of cutting tools, by a process of treatment recently developed in the Bethlehem Steel Company by Mr. F. H. Taylor and Mr. F. Maunsell White. The process is applicable to a number of self-hardening steels, but the best results are got with a particular alloy. This alloy, after subjection to the special process, retains its hardness even at a red heat, and in fact the tool is worked so hard that the chips turn blue as they leave the tool. The process is applied after the tool is ground to form, and the hardness is not superficial but penetrates to the centre of the bar to 4 inches square. The alloy used forges much easier than the ordinary self-hardening steels, and can be annealed so as to be machined into milling cutters or twist drills. In a demonstration at the works of the Bethlehem Steel Company a tool treated by this special process was used to take a cut 3-16ths of an inch with a feed of 1-16th of an inch, at the rate of 150 feet per minute; the material operated on being ·010 carbon steel; the experiment lasted some minutes and the point of the tool became red hot, but was found to be uninjured at the end of the cut. A tool of mushet steel, subjected to the same trial, lasted 5 seconds. In another experiment, hard cast iron was cut at the rate of 150 feet per minute with the specially treated tool steel; the experiment lasted 16 minutes. Mushet steel failed in 10 seconds."

The above is a great accomplishment in the way of getting tool steel to withstand the high speed cutting, but the high price of such steel would be a drawback against its adoption to a large extent, unless one used tool bars and holders, and reduced the quantity as low as possible.

The following are the results of some of my trials with English manufacture, and they compare favourably with the American experiments conducted on powerful modern machinery:—

A

| Material. | Diameter of material cut. | Speed in feet per minute. | Depth of cut. | Feed. | Time. | Condition of Tool. |
|---|---|---|---|---|---|---|
| | Inches. | | Inches. | Inches. | Minutes. | |
| Steel ... | 7¼ | 37 | 3/16 | 1/10 | 15 | Good |
| ,, | 15½ | 41 | 3/16 | 1/8 | 5 | Tool to Grind |
| ,, | 7½ | 29 | 1/4 | 1/8 | 9 | Good |
| ,, | 7 | 52 | 3/32 | 1/8 | 6 | ,, |
| ,, | 7 | 28 | 5/16 | 1/8 | 21 | ,, |
| Cast Iron | 16½ | 35 | 9/32 | 1/16 | 13 | ,, |
| ,, | 16¼ | 64 | 1/4 – 1/8 | 1/16 | 17 | ,, |

In all the above trials the tool was as good at the finish of the operation as at the start, with the exception of the second test. In this instance the tool had to contend with a very tough shaft, and partly chilled skin, the diameter also varying a good deal; the tool was working well within its powers.

B

| Material. | Diameter of material cut. | Speed in feet per minute. | Depth of cut. | Feed. | Time. | Condition of Tool. |
|---|---|---|---|---|---|---|
| | Inches. | | Inches. | Inches. | Minutes. | |
| W. Steel | 15½ | 40 | 7/32 | 1/10 | 4 | Good |
| ,, | 7 1/16 | 37 | 1/4 | 1/16 | 6 | Lathe stopped— Tool to grind |
| ,, | 7 1/16 | 37 | 1/4 | 1/10 | 3 | Good |
| ,, | 6⅝ | 35 | 5/32 | 1/16 | 8 | ,, |
| ,, | 6⅝ | 35 | 7/16 | 1/10 | 4 | Lathe stopped— Tool to grind |
| ,, | 6⅛ | 32 | 1/4 | 1/10 | 4 | Good |
| ,, | 6⅛ | 32 | 1/4 | 1/10 | 3 | Lathe stopped— |
| ,, | | | | | | Tool to grind |
| ,, | 6⅛ | 32 | 1/4 | 1/10 | 6 | Good |

We were handicapped in all the above trials for want of power, the machine pulling up as soon as a heavy cut was put on; tool

This tool was not adapted for high-speed cutting, but is as good as ordinary tool steel on a slow motion. As long as the speed was kept low, some fairly heavy cuts could be taken, but as soon as the speed was raised the edge of the tool went.

I have noticed the same thing in drilling a hole in a grindstone with a high speed and small feed; the tool lasted no time, but with a very heavy feed and a slow speed the drill worked well.

The whole of the above trials were conducted under unfavourable conditions to the sample, and we were fully convinced that of the three samples, A could do very much more than we had the means convenient to put it to.

Taking the speeds at which a drill can be run, I had a few rather peculiar examples shown to me of the erratic efficiency of one sample of tool. I was using a twist drill in a pneumatic drilling machine, when owing to the circulating water being cut off I could not work the air compressor and had to put the job on to a radial drilling machine, with the same tool, less feed, and a regular automatic one at that; the tool did not stand the wear in the tough material in hand as well as it did with an erratic hand feed and higher speed. There were two conditions under which this work was done. On the radial drilling machine the drill was working vertically, on the pneumatic driller, horizontally, and the cuttings seemed to clear themselves quicker.

Peripheral speed of drills in general practice is about that given in the annexed Table:—

| | |
|---|---|
| Brass ... ... | 25 feet—40 feet per minute. |
| Wrought Iron | 20 ,, —25 ,, ,, ,, |
| Cast Iron ... | 15 ,, —17 ,, ,, ,, |
| Steel ... ... | 14 ,, —20 ,, ,, ,, |

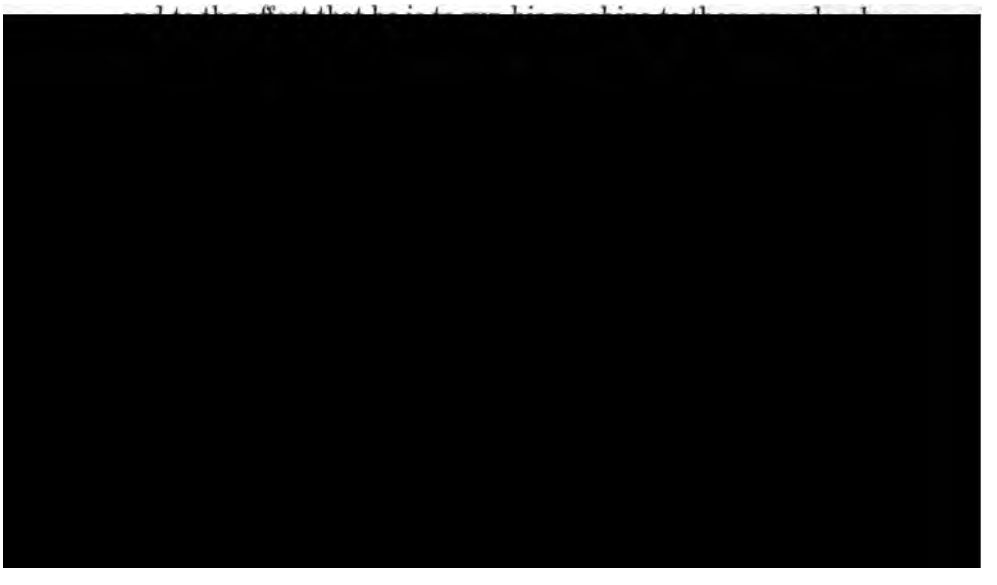
| | |
|---|---|
| Feeds—up to ½ inch | 200 revolutions to 1 inch feed. |
| ½ inch to 1¼ inches | 150 ,, ,, 1 ,, ,, |
| above 1¼ inches | 100 ,, ,, 1 ,, ,, |

Take the obstacle to maximum production (sometimes so) of the man who is working the machine. If a man is on piece work, and his piece price not cut, when he produces his finished job considerably faster than he did on time rate, you will notice his machine will be well taxed to get through the work both in feed and speed, and he does not seem to display the remarkable anxiety for the safety of the machine as he did on time. Can you blame him? I have often been told it is only pure laziness, or a mis-

taken policy on the part of a machine man, not to drive his machine to its utmost capacity; but he will find if he works his machine faster, that there are events likely to occur; and at a high rate of speed these events cast very small shadows before, so his mind must be on the job, not partly on it and partly on his own private concerns.

Where you cannot afford to pay the percentage demanded by piece rate, but still wish to encourage and stimulate your men to make things go, the system of premium on correctly finished work within a time limit is a happy medium between the two extremes and where adopted works well if the time limits have been carefully worked out and arrived at by a competent practical man who can tell pretty nearly to 5 minutes how long it should take to set a job, and it is generally in the setting that much time is lost. If we want to get machines to produce quickly as well as accurately, there is no use in having the best, and running it under the most favourable conditions, if it is to waste half an hour doing nothing. It would be like selecting a very fast locomotive and powerful to take an express through on a record time, and allow a fish train ahead to hold it up for 15 minutes. To prevent such a case occurring in machine shops give the man a liberal amount of unskilled help, and help him in a few ways, such as assisting him to obtain suitable packing, etc. It is often the dread of having to tackle the setting of a heavy job just at finishing time that causes some men to mark time for the last hour on a nice easy "self-act."

To obtain a maximum output and have your machine tools kept up to their work, it has been advocated to have speed curves and tables placed before a man's machine, in some suitable position, and the foreman instruct him as to the meaning of it,



the work in the machine, and the machine's strength of gearing and stiffness to stand the strain.

I referred to an ordinary planing machine as being sometimes a very inferior machine for the size of it, the amount of power required to drive it working and idle or reversing. We can help to improve this state of matters in a planing machine that is only fitted with one head, by putting two or three tools into a patent tool holder, and with the one lateral traverse remove a lot of material, if the job is anything of a plain surface.

Milling machines are tools that can be run to their utmost capacity and that as a rule is of high productive rate; they are made rigidly, and except in those types where in a very long job the table overhangs to such an extent as to spring it downwards, we can get an accurate result. There is great variation in practice regarding these types of machines; their advantage over the slotting machines or shapers is that the tool is cutting all the time. They can be run at considerably higher speed than other tools, because each tooth is in contact for only a small portion of the revolution and has a chance of getting cooled by the water or whatever lubricant is used for that purpose. The following speeds are the results of experience, but are by no means the maximum attainable with new and powerful machines.

| | Roughing Cut. | | Finishing Cut. | |
|---|---|---|---|---|
| | Feet per minute. | Revolutions per minute. | Feet per minute. | Revolutions per minute. |
| Steel ... ... | 30 | $\frac{57}{r}$ | 40 | $\frac{76}{r}$ |
| Wrought Iron ... | 40 | $\frac{76}{r}$ | 55 | $\frac{105}{r}$ |
| Cast Iron ... ... | 60 | $\frac{114}{r}$ | 75 | $\frac{143}{r}$ |
| Brass . ... | 100 | $\frac{190}{r}$ | 120 | $\frac{228}{r}$ |

"$r$" radius of cutter in inches.

Although the milling machine has many advantages over the slotting machine, yet there are certain jobs that a milling machine cannot get through with so satisfactorily as the latter can, and in my opinion a slotting machine well worked is a very useful tool; the milling cutter cannot negotiate corners as the slotter or shaper can.

The slotting machine and the shaper are, in my experience, machines to take a first-class specimen of tool steel and run with a good cut on and fairly heavy feed, but slowly, as at a high rate of speed most reciprocating machinery soon shakes itself loose in parts that we don't notice until some mischief is done.

The system of feed from a stepped cone and a little strap is a poor one, and no matter how tight one gets that little belt, its size allows it to stretch by being taken off and put on again, and it requires constant readjusting. This is superseded in modern machinery by gear feed, and in the lathe I took experiment A with the sample, I have always had to use change wheels and the leading screw owing to the feeding gear being so fast on the slowest motion even.

English practice generally is a long time in accepting the grinding machine, such as emery corundum or such type of wheel, either as a roughing out or finishing machine, although they are extensively used abroad. This system is both accurate and expeditious, both for internal or external diameters, and the run at a peripheral speed of 3500 feet per minute on very hard material.

This subject of the speed of machine tools is a wide one and worthy of far more able pens than mine. Yet I trust my humble efforts will serve to " draw the fire " of some of our members, who may agree with me that the machine shops are the most important part of a commercial engineering works.

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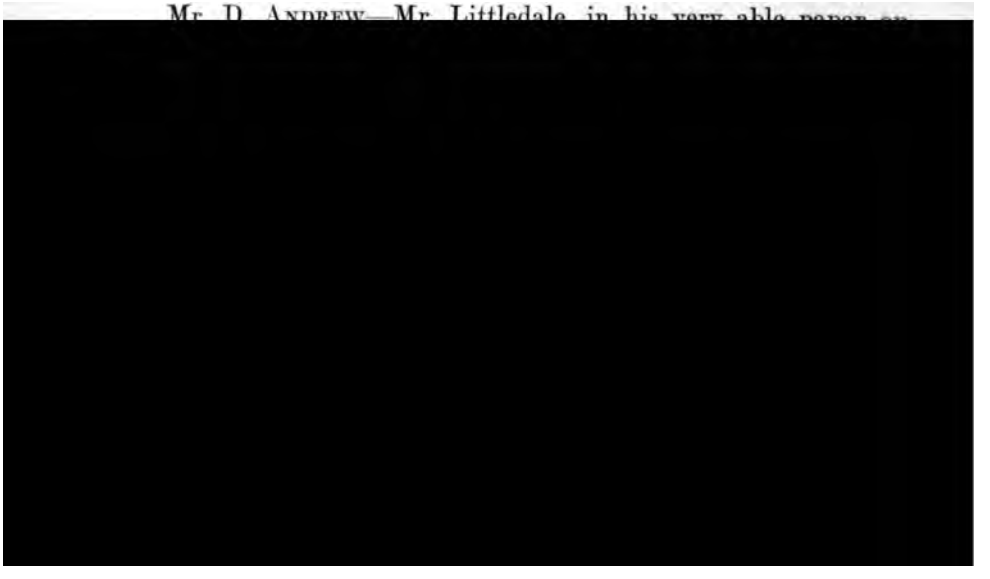
## DISCUSSION.

Mr. D. Andrew—Mr. Littledale, in his very able paper on



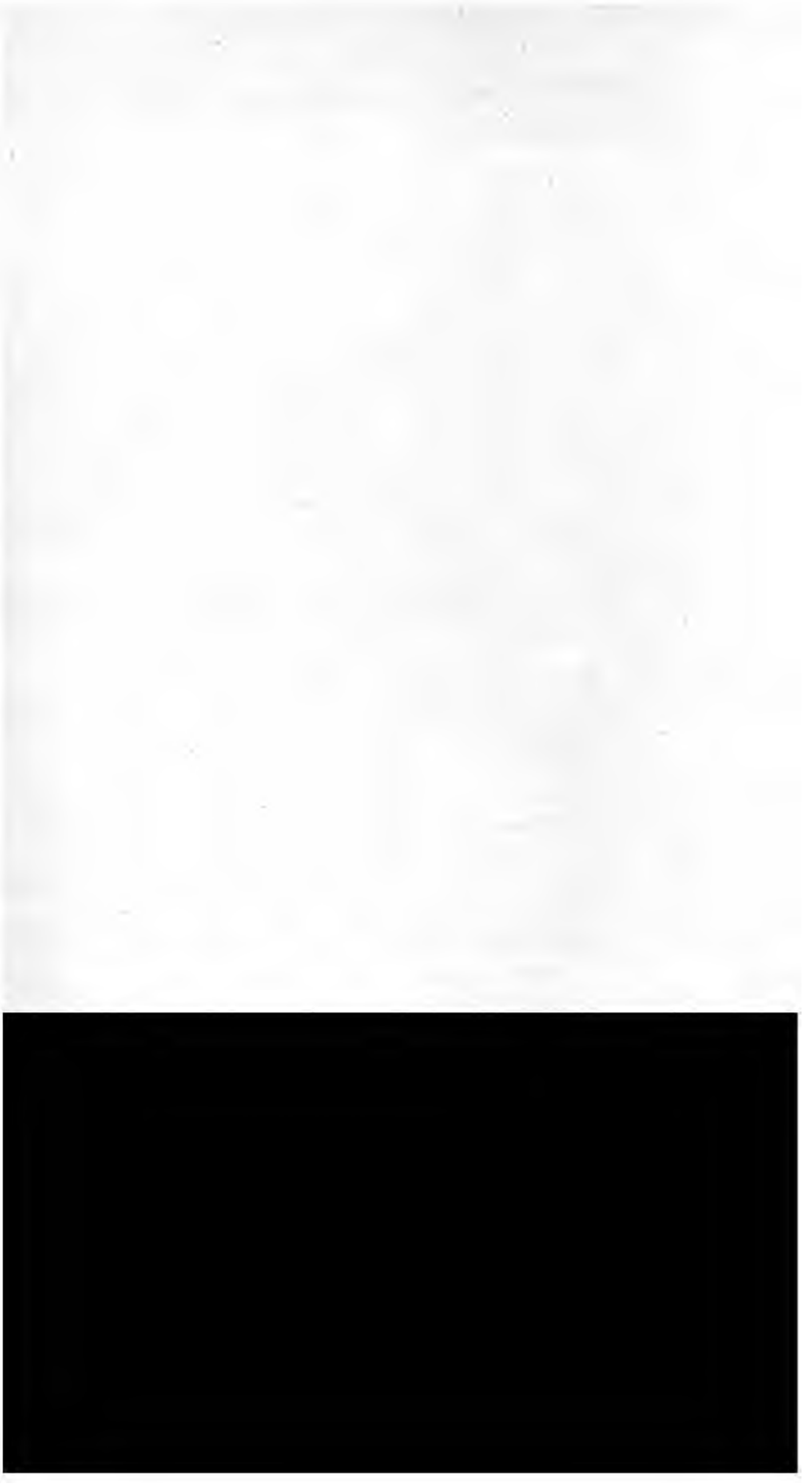
universal use in all departments of engineering, and also in ship-building. I would have been very pleased had Mr. Littledale gone a little further into the matter of pneumatic tools, and in his reply he might do so, because it is, in my opinion, a subject that comes within the scope of his paper, and would add very much both to its interest and value in having Mr. Littledale's experience with this class of tools.

Mr. W. G. SPENCE—I think that before beginning any discussion on Mr. Littledale's paper I can only say that personally I feel very much obliged to him for it. I feel doubly so for two reasons: Firstly, that I think it an excellent paper on the subject he has dealt with, and secondly, it is a type of paper we get far too few of. It is a paper that requires to be read, and as I have not had an opportunity of doing so carefully I have only been able to jot down notes while listening to it; but with so many points we ought to get some discussion. For instance, he at the outset observes: "Also what little notice is taken of the practical working of machines in technical colleges as a rule." That is one of the few points on which I feel at variance with the writer. Personally, I think that technical colleges are not the places to teach about machine tools at all. A youth had better be taught there to think. The actual practical work can be better learned in the works. He mentions the importance of deluging tools with an efficient lubricant. That is a point that has come much more to the front in the last few years. There is a wonderful difference between a machine cutting with a can dripping water in the old way and a machine fitted with a pump attachment deluging the tool with liquid. Especially will this be the case if the liquid is a good oil, preferably lard oil. The waste is very little if the machine is suitably constructed and fitted with a proper sump for the oil to drain back into, as is the case with all automatic tools. Another point mentioned is the great variation of ratios between the steps of the speed cones. That is a difficulty in many machines. Another difficulty with the present high class of tool steel is to get a sufficiently great total range of speed, that is, a speed sufficiently high for some classes of work and slow enough for others. A good arrangement is to have two sets of fast and loose pulleys on the counter-shaft—a small pair for the high speed steel and a larger pair for other work. I have

tried a number of these high speed steels and have found a good deal of difficulty with belts slipping, and want of power generally, and arrangements to meet this will require to be made in many works. Mr. Littledale speaks of direct attachment, electric motors and switches. I have seen such arrangement for light work on a brass lathe, it admitted of a great variation of speed, which variation could be obtained by simply moving the switch handle. How it would answer on heavy lathes I am not in a position to say. Another thing Mr. Littledale deals with is the question of supplying men with proper tools. This is one of the most important matters in the machine shop. It is about five years since I adopted the system advocated in the paper and railed in a proper tool and fettling shop, having a regular tool grinder, so that no machine man grinds a tool, he simply touches it upon the stone, and when it gets bad hands it back to the store and gets another ready ground in return for it. The difference between a tool ground on a proper grinding machine by an experienced grinder who does nothing else but grind tools from six in the morning to five at night and one ground haphazard on an ordinary stone by anybody is as great as that between chalk and cheese. The latter practice is being rapidly rooted out. There are several good tool grinding machines in the market, and one I put down about five years ago, beyond renewal of the emery wheels, has not cost half a sovereign in repairs, and the man will grind as many tools in a day as can be needed for a good-sized machine shop. For efficiency in the machine shop such a system is of primary importance. Every man knows that instead of going on with a worn-out tool he has just to hand it in and at once get a sharp one. Mr. Littledale remarks upon using a number of tools for

faster than that. In speaking of piece work Mr. Littledale seems to consider the foreman is the better man to fix prices. The difficulty I find is this: in the machine shop the usual number of foremen employed have enough to do in looking after the proper rotation of jobs, policing the shop and other departmental work and have no time to properly consider piece prices, the result is that piece work has generally fallen into abuse more through that than anything else. To fix piece prices properly a separate staff is necessary. Mr. Littledale speaks of tables and curves being made out for varying diameters of work and materials for each machine, but the difficulty was to get these used. What I have done on most of the principal machines is to have proper tables put up having a sketch of the cone pulleys clearly shewn on same, each pulley being marked by a reference letter and a note as to whether the back gear is to be in or out. By a glance at the sketch and reference to the table the proper pulley on the cone and gear can be seen at once for any diameter in any material for roughing or finishing cuts. That is about all I have to say on the paper, except, perhaps, that he mentions grinding, which has come to the front. He says it might be useful for roughing-out. I have not been able to use grinding for roughing economically, but for finishing piston or slide rods or work where you require a true surface and accurate diameter there is no other method that I know of equal to grinding. Some special grinding machines may be able to rough out economically but I have had no experience with them. In conclusion I have only to thank Mr. Littledale for his very interesting paper, and congratulate the Institution on his having brought forward an useful and controversial subject.

The discussion was adjourned and the meeting dissolved.



# NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

EIGHTEENTH SESSION, 1901-1902.

## PROCEEDINGS.

SECOND GENERAL MEETING OF THE SESSION, HELD IN THE LECTURE HALL OF THE SUNDERLAND LITERARY SOCIETY, FAWCETT STREET, SUNDERLAND, ON FRIDAY, DECEMBER 13TH, 1901.

HENRY WITHY, ESQ., J.P., PRESIDENT, IN THE CHAIR.

The SECRETARY read the minutes of the previous General Meeting, held in Newcastle-upon-Tyne on 15th November, 1901, which were approved by the members present and signed by the President.

The ballot for new members having been taken, the President appointed Mr. W. H. Dugdale and Mr. R. H. Muir to examine the voting papers, and the following gentlemen were declared elected:—

MEMBERS.

Andrews, Edward W., E. Engineer, c/o Messrs. F. Reid, Ferens & Co., Orchard Street Buildings, Newcastle-upon-Tyne.

Beckett, Frank, E. Engineer, 8, Woodbine Place, Coatsworth Road, Gateshead-on-Tyne.

Chicken, Christopher B., Engineer, 17, Kenilworth Road, Newcastle-upon-Tyne.

Douglas, William Y., Engineer, c/o Messrs. Douglas Bros., Globe Iron Works, Blaydon-on-Tyne.

Harris, John, Engineer, Truro House, Hotspur Street, Tynemouth.

Smissen, C. Van Der, Supt. Engineer, c/o Messrs. Hamburg-American Steamship Co., Hamburg.

## GRADUATES TO MEMBERS.

Böcler, Harry, S. Draughtsman, 19, Azalea Terrace South, Sunderland.
Browne, Benjamin C., jun., Engineer, 58, Brighton Grove, Newcastle-upon-Tyne.
Carnegie, Alfred Q., E. Engineer, 21, Eldon Place, Newcastle-upon-Tyne.
Coulson, Richard H. A., Marine Engineer, 12, East View, South Shields.
Dixon, John Thomas, Engineer, 27, Meldon Terrace, Heaton, Newcastle-upon-Tyne.
Dobson, Wm. G., Shipbuilder, The Chesters, Jesmond, Newcastle-upon-Tyne.
Doxford, Robt., jun., Shipbuilder, Silksworth Hall, Sunderland.
Hamilton, James, E. Draughtsman, Beech House, Mile End, Stockport.
Hammond, Fleetwood C., E. Draughtsman, c/o Messrs. Cowpen Coal Co., Ltd., Cowpen Colliery, Blyth.
Hepburn, James M., Marine Engineer, 17, Grosvenor Place, Newcastle-upon-Tyne.
Hills, Lawrence, S. Draughtsman, 2, Somerset Terrace, East Bolden, Newcastle-upon-Tyne.
McCoull, Cecil, Electrical Engineer, 94, Drayton Park, Highbury, London, N.
Moss, William, Engineer, Kirkview, Shipley, Yorkshire.
Nelson, George, Marine Engineer, 54, Cardigan Terrace, Heaton, Newcastle-upon-Tyne.
Patterson, Robert O., Engineer, Thorneyholme House, Blaydon-on-Tyne.
Posgate, James S., Marine Engineer, Durham House, Windmill Street, Gravesend, Kent.
Routledge, Herbert J., E. Draughtsman, Stapleton House, Jarrow-on-Tyne.
Turner, Charles N., Engineer, 21, Lansdowne Terrace, Gosforth, Newcastle-upon-Tyne.
Watson, John, S. Draughtsman, 24, Wandsworth Road, Heaton, Newcastle-upon-Tyne.
Wright, George H., Engineer, 23, Albury Park Road, Tynemouth.

## ASSOCIATE.

Murray, Henry H., Accountant, Hastings Lodge, Hartlepool.

## GRADUATES.

Bailey, Ralph U., Engineer, 3, South Avenue, Ryton-on-Tyne.
Burgess, Norval H., S. Draughtsman, 46, North View, Heaton, Newcastle-upon-Tyne.

## ADJOURNED DISCUSSION ON MR. J. W. E. LITTLEDALE'S PAPER ON "THE SPEED OF MACHINE SHOP TOOLS."

The discussion on Mr. J. W. E. Littledale's paper on "The Speed of Machine Shop Tools," read at the previous General Meeting, was resumed.

Mr. WILLIAM J. PAULIN—Mr. Littledale has presented his views of a most important branch of engineering in an able and practical manner. He has pointed out the principal lines on which modern machinery is built, with a view of obtaining higher cutting speeds, greater accuracy in finish, with greater production. One question very much to the point he asks, in connection with new revelations: "Why don't they do that on old-fashioned machines?" A common enough answer would be that the old machine was built to cut wrought iron, and so had not the stiffness and rigidity possessed by modern machines in these days of tough steel. Where we do possess an old machine with sufficient belt power, and of rigid construction, unless the longitudinal feed is driven from the lead screw, we find it driven by a slow moving narrow belt, the power available from which is inversely as the demand upon it. From personal experience I have found that given these conditions I have just mentioned, an excellent plan to get what is here plainly required, a positive feed, is to use sprocket wheels and a chain drive. In this way I have been able to increase a frictional feed, whose fastest speed was 20 to the inch, to 9¾ turns to the inch pos., the lathe standing up to it splendidly, although the rack drive to the saddle was placed on the side of the bed farthest from the tool. Mr. Littledale's experiments in tool steels of English manufacture are very interesting and are, I think, more in keeping with English practice, where he obtains an increase of over 50 per cent., still maintaining heavy cuts and feeds. The high rate of speed on cast iron obtained in test A prompts me to ask if this was not a second cut, say, over a plain face with no interruption in its surface, from which a first cut had cleared off the hard skin. So much depends on the cast iron itself, the amount of sc ı in its composition, and

the kind of it, that in milling operations with cylindrical roughing cutters, with interrupted cutting edges, I have cut wrought iron and mild steel at 54 feet per minute with, of course, plenty of lubrication, and have found the same amount of wear on the tools as if they had run on cast iron at 35 feet. In milling cast iron the first edge the tool attacks should be chipped, or, in small work ground, to get below the skin, as this saves frequent grinding of the tool. In making tests with special steel on a very powerful 15 inches centre lathe, fed by leading screw driven by $3\frac{1}{2}$ inches belt running at 920 feet per minute, we were able to carry a $\frac{5}{16}$ cut on $\frac{1}{8}$ inch feed on hard steel shaft $7\frac{3}{4}$ inches diameter, running about 35 feet per minute for about 1 hour, the tool being in good condition at the end of the trial. We could get no higher speed which would carry the cut. I was obliged, therefore, to come to the conclusion that to get the highest possible results from this steel, specially designed roughing out lathes were necessary; or, as Mr. Littledale has suggested, independent motor driving, which would give the increased horsepower necessary, by increasing the driving belt speed, and allowing us to place the lathe in heavier gear. One thing seems noticeable in these trials—that the increase of power necessary to drive at these higher speeds seems out of proportion to the increase of speed. In referring to the want of stiffness in a machine Mr. Littledale suggests assisting matters to a certain extend by reducing the feed and depth of cut, and so gaining a higher speed with special tool steel. Particularly in cast iron I have found this of very little use, the inequalities in the surface where the skin remained unbroken rubbing down the cutting edge of the tool in no time, causing

feed varies with the machine speed we now feed at $\frac{1}{14}$ inch per minute, and no ordinary range of feeds would enable us to gear up to a suitable feed. But if, on the other hand, the feed is driven independently from the countershaft, we are still running at 1 inch per minute, and, if we desire, still able to increase, say up to 3 inches per minute. One word with regard to the high speeds of cutting given as American practice. We expect rather tall stories from America, and generally get them. The Bethlehem tool steel gave remarkably high speeds, no doubt, but the cut and feed for so powerful a lathe and so large a shaft was absurdly light, and a personal inspection of a twist drill about $1\frac{1}{4}$ inch diameter made from this steel, which had been driven through mild steel at a very high speed, convinced me that to do the same thing again with that drill was a manifest impossibility, as the drill was so worn on the circumference as to be smaller at the cutting diameter than further up the drill. And those members who have witnessed any drilling with twist drills in this condition will agree with me that the amount of trouble encountered hardly warrants its repetition. There is, however, no doubt that we are now in possession of new and excellent tool steels, and practical papers on the subject of their use such as Mr. Littledale has given us, with its tabulated experiments, widens our information in a way which is valuable, and it affords me great pleasure to join in the general appreciation with which Mr. Littledale's paper has been deservedly received.

Mr. P. M. BENNET—I must congratulate Mr. Littledale on his paper, to which I listened on the 15th November with great interest. With regard to the out-of-date machinery, many firms, I believe, are accustomed to put away to a depreciation fund from 10 to 15 per cent., but one often sees in these firms machine tools of perhaps 15 years of age. I should think a depreciation fund of 10 per cent. should only see machine tools of from 7 to 10 years of age. Some short time ago I was enabled to make a few tests with several tool steels, and I found that none of these could compare with the Bethlehem tool steel tests, though apparently these are not quite as good as reported. I have a few photographs here with a table of the results which I will not trouble to read to the meeting I

will hand them over for insertion in the *Transactions.* (See Plates I. to IV.)

The photographs show two positions of each tool, and each tool stood one test of a certain duration. Mr. Littledale gives us three tests with three different tool steels, but the comparative prices given were sample C half the price of sample B, and sample A a third greater than sample B. Would it not be better to give us the actual prices? I have attached to my list of tests the prices of the tool steels, and of course, the prices have a very great deal to do with it. One comes across tool steels which are charged sometimes three times their actual value in cutting quality. I must join in the general congratulations to Mr. Littledale on his paper.

Mr. H. E. HOLLIS—I do not propose to offer anything in the shape of criticism upon Mr. Littledale's paper, but as the subject with which he deals has during a period of close upon twenty years come rather prominently under my notice, and especially so during the last twelve months, I should like to say that I think Mr. Littledale has placed the Institution under an obligation to him for having brought the subject before it, and given an opportunity for discussion upon a subject which undoubtedly at the present time is engaging the attention of most engineers. If I did venture to make any criticism upon Mr. Littledale's paper I should say that in my humble opinion he has perhaps rather given consideration to what seem to me to be comparatively unimportant points, to the exclusion of the first principles or causes upon which the speed of machine tools greatly depends. But I think that this paper ought to

ditions and management of belting, and subjects of that sort. Further discussion might be interesting on power itself—on the relative merits, disadvantages and advantages of steam and electric power. There are advocates of both, and it would be very interesting to hear these advocates thrash out the subject at an Institution meeting. Coming nearer home a further discussion might take place, or a small paper be read upon the use and dreadful abuse of tool steel. There is a good deal to be said upon this subject and the management of it. Mr. Littledale in his paper rightly refers to the necessity for setting up a proper standard or a proper system of grinding tools. It seems to be thought by some people that any man can grind a tool. Any man cannot grind a tool, any more than any man you meet in the street can cut your hair. There is a right and a wrong grinding angle for tools, and amateur grinding ought, as far as possible, to be done away with. A grinder is a skilled person, and the sooner you can do away with amateur grinding the more likely you are to get the maximum results out of your machinery. Of course, supposing all these things are put right, I don't suppose for a moment that all your difficulties are over, because, after all that, you have the men to deal with, and there is no doubt at all that, generally speaking, they are a little suspicious and jealous about these high speeds. They don't altogether care about them, as I gather from experience, for after making numerous tests and getting highly satisfactory results, at the end of four, five or six weeks one goes back and finds that in spite of these satisfactory results the old speeds have been returned to and nobody seems to know exactly why. That difficulty can only be met by having a close system of inspection in your shops. It should be the duty of some official to keep his eye on that point—to go round the shop and see that the tools are working up to their capacity—as apart altogether from this high speed question, I venture to say, with the present conditions, and present appliances and ordinary steels there would be very little difficulty in many places in getting something like from 10 to 20 per cent. higher efficiency out of the tools than possibly exists at the present time. I do not think that I ought to trespass more upon the meeting. I ought, indeed, to apologise that I, a layman, should have the assurance to get up and address the meeting at all,

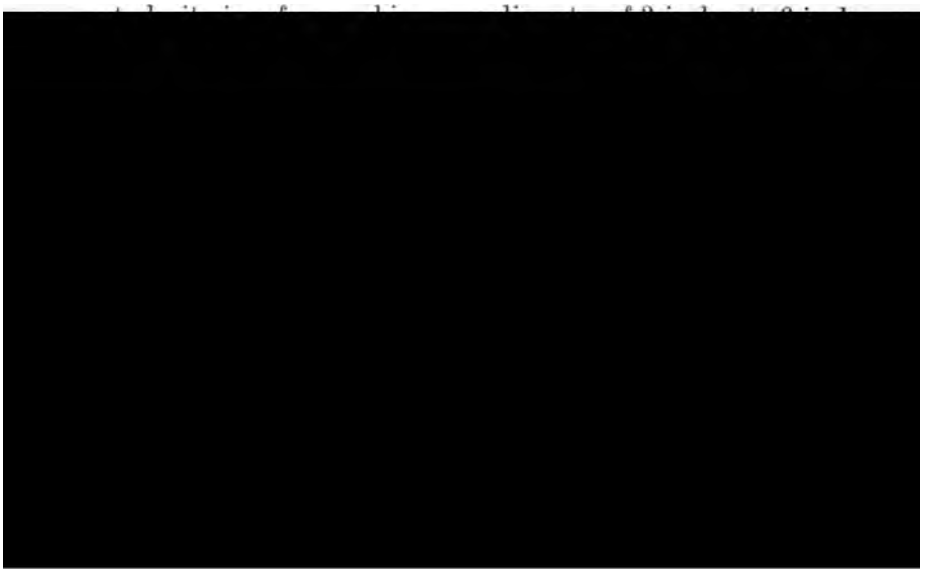
but I hope I may claim your forbearance, and the forbearance of the meeting, for having done so. I have no desire to grind my own axe, or to begin to institute any comparisons between the steel made by my own and other firms, but before I sit down I would like to say, on behalf of myself and British tool steel manufacturers, that there is no necessity for gentlemen in this country to go either to the States, or to France, or to any foreign country to obtain steel, because you can get in this country steel that will do all you require for the power you have got, or are likely to get, to give it.

Mr. William Thompson, by invitation of the President, addressed the meeting. He said—As a visitor I would like to put before you a few remarks on behalf of my partner, Mr. James Rowan, who is a member of your Institution, regarding the subject which Mr. Littledale has brought before you. We look upon this as an exceedingly important matter indeed. We think too little attention has been in the past devoted to this subject, and I am very glad to think, and to see, that there is a very lively and increased interest being brought to bear on this important matter. Mr. Rowan writes me as follows:—"I quite agree with Mr. Littledale in his remarks near the beginning of his paper, that it has struck him as peculiar how loth young engineers sometimes are to go through the machine departments when learning their trade. That is also most emphatically our experience. Whether an apprentice engineer considers it beneath his dignity to work a turning lathe, or what it is, we cannot say, but we know assuredly he goes to a machine with a grudge. The output of a

plant; a careful selection of that plant, and, as much as possible, special machinery for special work. We have found by experience that it is no use attempting to fix up old machines to do good work. It is cheaper to buy new ones, and certainly to buy the best. The last factor mentioned by Mr. Littledale is an important one, viz., 'The man who works the machine.' I would suggest that the introduction of a premium system, or some sort of encouragement, would help matters, but it is not as a rule so much the men who are to blame as the management, which is often satisfied with dirty, badly lighted workshops, and no artificial heating. In other words the men are often asked to work under conditions which no manager or employer would care or wish to work under unless he were compelled to. Employers are unwilling to part with old tools, looking upon them as good old friends, but if employers would have sufficient pluck to introduce a premium system and follow it up closely they would soon learn the advantages of good machines, modern appliances and modern methods of doing work and would not be satisfied until they were adopted. Mr. Littledale states:—'You will notice in such a case, that the tool that is inverted, and has the lubricant dripping on its point, will last longer than the one on the side that has the water dropping on to the shaving of material and dribbling uselessly down the side.' I beg to differ altogether from this statement. I have satisfied myself on many occasions that there is no appreciable difference, and I should like to hear from Mr. Littledale what data he has to give for arriving at this conclusion. Mr. Littledale states in reference to the premium system, that 'A competent practical man who can tell pretty nearly to five minutes how long it should take to set a job.' This is by no means our experience, unless it is such a simple job as putting a shaft into a lathe which has previously been centred; but take such jobs as these which are placed in slotting machines, on face lathes, on drilling machines, and it will be found that men themselves doing the same jobs will not repeat them within a far greater limit of time than five minutes. The speeds and feed given by Mr. Littledale in the table of cutting speeds are not what might be done or what is done every day in workshops provided with good machines, and speeds from 25 to 50 per cent. greater than

mentioned are in every-day use in modern workshops. Too much importance should not be attached to the expression 'speed.' It will be found that some workmen are fond of cutting at a high speed with a light feed, and others cut at a slow speed with a coarser feed. In many cases the time taken to do the job will be practically alike."

Mr. CHARLES BLOW said—The subject of Mr. Littledale's paper is one of great importance in a district like ours, in which are such a large number of engineering works, and I think we are very much indebted to him for the trouble taken in preparing it. Under Mr. Littledale's headings the first is "want of stiffness in a machine to stand a high rate of cutting speed and heavy feed." This is one of the principal factors preventing machines being run at high speeds, but in my experience I have found many cases where the speeds of machines could be increased much beyond what has been the usual practice, without reducing the feed or depth of cut, as suggested by Mr. Littledale, as in my opinion the reduction of either or both of these defeats the object aimed at by all engineers when increasing the cutting speeds, that is, to increase the output of a machine in a given time. I think it is better to start with the largest feed and cut that a job will stand without springing and then put up the speed of your machine to a little within the limit of driving power and the failing point of your tool steel. Referring to the cutting speed and feed table, given in the paper, as being slightly in excess of the majority of English speeds, I think in these Mr. Littledale is a long way short of what has been usual in many of our local shops. Take the table for



feet per minute, the difficulty in the past has been to get a tool steel that would keep its cutting edge good, when heated up by the work done. Recently, however, as mentioned in the paper, English steel manufacturers have introduced steel mostly of the air-hardening type, which retains its cutting edge when heated up to an abnormal degree. This property enables much higher cutting speeds to be adopted with economy. The firm with which I am connected are makers of a steel of this class, which is easily made up by any good toolsmith, and is capable of keeping a good cutting edge at speeds 75 per cent. to 100 per cent. higher than was customary a very short time ago, the cuts and feeds being much the same as usual. One general result of my experience in introducing this steel is that the limit of driving power of the lathe is reached before the failing point of the steel. This has been realised by engineers and where possible they are putting down new plant with more driving power and to run at higher speeds. As instances of what is being done with this steel on ordinary good lathes, not by any means new, I may say that in a number of shops on the north-east coast and other districts marine and similar shafting is being roughed out at speeds from 50 to 60 feet per minute with the usual cut about $\frac{3}{8}$ inch to $\frac{1}{2}$ inch deep, and a feed of 8 per inch. Others, again, being limited by their machinery to speeds of about 30 to 40 feet per minute get over the difficulty in a measure by using a feed of 4 per inch, and some are working with a feed of $\frac{3}{8}$ inch per revolution. Tools on work of this class will often stand for a whole shift without grinding. Looking on the economical side of the use of such cutting steel as I have mentioned you have a saving in time in the finishing of machine work on a job which is very often of the greatest value; again, I know cases where men have been on piecework, where the piecework price has been reduced by 33 per cent. to 40 per cent. To give those that have not seen work done at the high speeds and large feeds mentioned, an idea of the amount of material removed, I have with me here a number of shavings which have been taken off at different works, which speak for themselves. I thank you for the opportunity of expressing my opinions.

Mr. LITTLEDALE, in reply to a question by the Pr t, said e would reply on the discussion at the next gene.

# THE BALLASTING OF MODERN TRAMP STEAMERS.

By E. C. CHASTON.

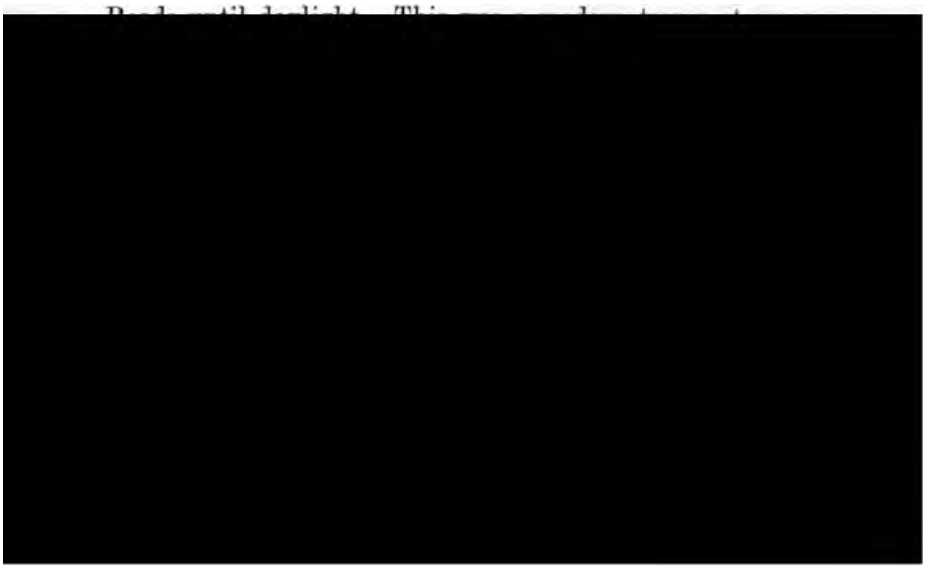
[Read before the Institution at Sunderland on December 13th, 1901.]

In looking over the proposed syllabus of papers to be read before the Institution this session, 1901-1902, the writer finds heading the list, "The Ballasting of Ships," and he was very pleased to see that this subject had been suggested by the Council. The writer cannot attempt within the limits of this paper to deal with this subject in all its bearings as fully as its importance deserves, but it is to be hoped that in the discussion, which he trusts will follow the reading of the paper, the whole matter will be gone into in all its details, and that the light thrown on the subject will be the means of pointing out to underwriters, shipowners and others concerned in the welfare of the mercantile marine the short-sighted policy of sending ships to sea in an unseaworthy condition, due to want of sufficient ballast.

If we go back to January, 1897, and take the salvage cases due to broken shafts, loss of rudders, etc., up to the present time, one can only express surprise that such a state of things is allowed to exist. Writing as one who has a practical knowledge of the subject, the writer admits that up till about four years ago he was inclined to think there was something radically wrong with the shipbuilding and marine engineering profession respecting the scantlings of both hulls and machinery. But after carefully looking into the cause of shaft breakages and disabled rudders, broken or fractured rudder posts, etc., he came to the conclusion that insufficient ballast was and is the cause of three-fourths of the whole trouble, and that it is imperative (if the shipowner will not, and the underwriter does not, insist upon a vessel being sent to sea in proper ballast trim) that there should be an under-load line fixed

by the Board of Trade or the authorized freeboard-assigning authorities. In the present type of 6,000 to 7,000 tonners, length, B.P., 350 feet; breadth, 47 feet; depth, moulded, 29 feet 6 inches; with all tanks full, boilers full, stores on board and 600 to 700 tons bunker coals, ready to sail to the westward, the ballast draft would be approximately 12 feet 3 inches aft and 8 feet 2 inches forward, or a mean draft of 10 feet 2½ inches. If we take the centre line of shafting at 10 feet 6 inches from the base line of the vessel and add half the diameter of the propeller boss, say 1 foot 4½ inches, this will give 11 feet 10½ inches from the keel to highest part of propeller boss, or in other words the boss of the propeller would be submerged 4½ inches. Apart from this data, which is quite in keeping with present-day practice, the writer has often seen propeller bosses two, three and four inches awash on vessels leaving continental and the lower Mediterranean ports for the United Kingdom coal-loading ports.

In addition to the risks of shaft breakages, machinery damage, etc., vessels in the trim described above are quite unmanageable in a fresh breeze—due to the fact that they will not answer their helm—they fall off before the wind and become a source of danger to navigation in such places as the English Channel, Bristol Channel and Irish Sea. The writer has been on board of a modern tramp 6,300 tons dead weight going from Liverpool to Newport, Monmouthshire, in ballast in a moderately fresh breeze, wind ahead, when the vessel kept continually falling off her course and turned completely round time after time; and in no case could the master get the vessel's head to wind under an hour. Arriving off Swansea at nighttime, the master would not risk taking his vessel amongst the traffic in the dark but dropped anchor in Swansea



charter, and during the three months freights to Aden had fallen 4s. per ton, so the vessel lost in freight alone £1,100 on her outward fixture and a further loss of £320, say eight days at £40 per day added to this, coaling and harbour dues, port charges, etc., at Corcubion, at least another £150, making a dead loss of £1,570 to the owner on a fourteen days' run. This loss was solely due to insufficient ballasting of the vessel, and not necessarily to stress of weather, the log book recording fresh winds on bow, sea moderate, with swell on bow.

This is one of, we may say, hundreds of cases proving the great money loss to shipowners through neglecting to have their vessels in proper ballast trim. It is surprising to think that shipowners in far too many cases will not go to the expense of paying the cost of the necessary extra ballast to put a ship sufficiently down in the water for a run across the Atlantic light. The cost of sand ballast to-day is a mere bagatelle in comparison with the loss sustained by a long passage owing to the vessel being too high out of the water. To demonstrate the value (to shipowners) of having a ship sufficiently or properly ballasted, the writer gives below the performances of a few vessels running across to North America in ballast trim. Steamship (A), length, B.P., 340 feet; breadth, extreme, 45 feet; depth, moulded, 28 feet; I.H.P., 1,234 to 1,250; speed 9 knots; deadweight, 5,697 tons on a mean draft of 22 feet 10½ inches. The above vessel, when water ballasted only and with 600 tons of bunkers on board, had a draft of 13 feet 2 inches aft and 11 feet 1 inch forward, the distance from the base line to the centre line of tail shaft being 10 feet 6 inches, the diameter of shaft, 12¼ inches, and the diameter of propeller boss 2 feet 9 inches, thus giving 9¼ inches immersion of propeller boss in smooth water; the diameter of the propeller was 17 feet. This vessel used to take 19 to 25 days on the passage from the north-east coast ports to Hampton Roads, U.S., and Delaware breakwater, U.S., and invariably arrived with machinery defects and was eventually towed into the Azores with broken shaft and loss of propeller, the shaft having gone at the largest part of the cone. There was no trace of corrosion or other defects, the shaft was in perfect line, and the fracture was as clean a break as any one could wish to see. The cause was directly traced to want of sufficient ballast. After such experiences and consequent loss through delay, salvage and towage home, the owner decided to have his ships sufficiently

ballasted, with the following results, in this particular case of A, of three successive voyages:—

August, 1897.—In addition to her water ballast and 600 tons of bunkers, she took 500 tons of sand ballast at 1s. 6d. per ton, f.o.b., and sailed from Blyth on August 14th, arriving at the Delaware breakwater on August 30th, 15½ days on the passage, with an average speed per day of 228·9 knots.

October, 1897.—Left the Tyne on October 11th for Hampton Roads. Arrived there on October 29th. Average speed per day 221·9 knots over a period of 17 days. She had on this voyage 750 tons of sand ballast at 2s. per ton, f.o.b., about 400 tons of this being on deck. The quantity of bunkers and other conditions were the same as previous voyage.

December, 1897.—Left the Tyne on December 12th for Hampton Roads and arrived December 31st. Average speed over a period of 18½ days, 194·5 knots. During this passage some exceptionally bad weather was experienced, and innumerable vessels put back in distress and in a more or less disabled condition. The writer does not wish to state any more cases in detail, but he has data of four ships similar to A, doing the same work or voyages, viz., to the United States in ballast regularly and home with cargo. The approximate drafts, with sand ballast, are 17 feet 8 inches aft and 13 feet 6 inches forward, ranging down to 16 feet 4 inches aft and 13 feet forward according to the time of the year. The speeds given in ship A are not necessarily given to show the speed of the vessel, but to show the regularity of speed or passages made. Machinery damage was practically *nil*, there being no shaft breakages or rudder defects during the last four years. After experiences like the above one would be surprised at any ship-

Institution in 1898, or in 'tween deck tanks as per Diagrams 1 to 4. The writer does not advocate any special form or means of ballasting steamers, but he does wish to draw attention to the vast amount of damage done to modern tramp steamers generally, and their machinery in particular, due to the want of sufficient

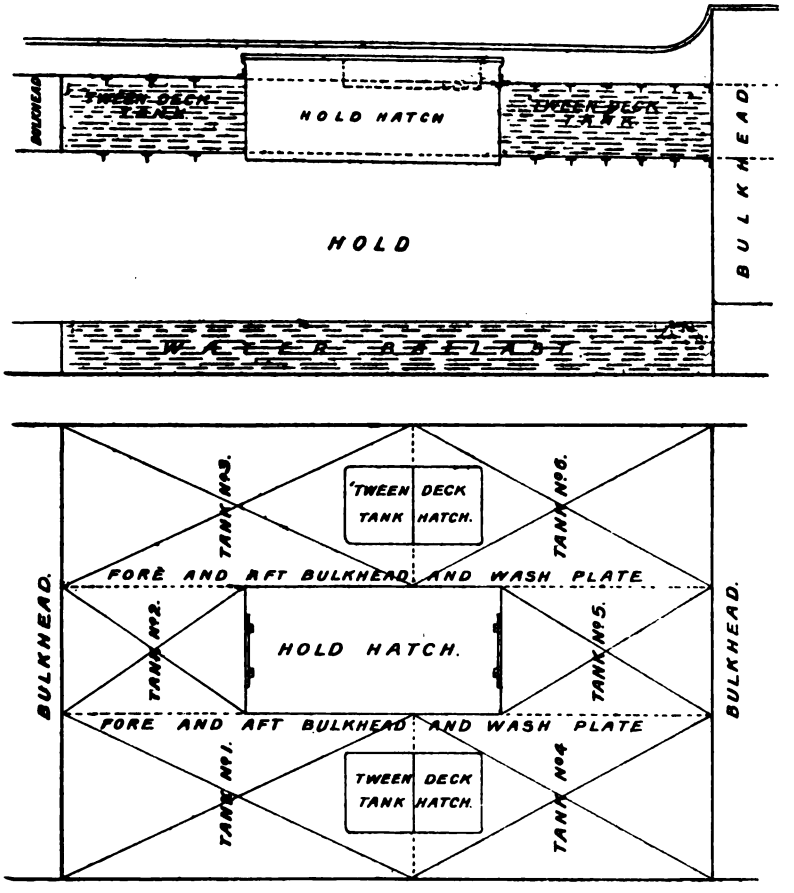


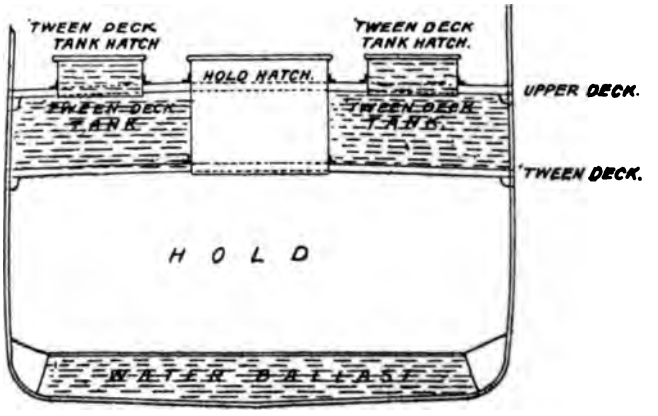

DIAGRAM NO. 1.

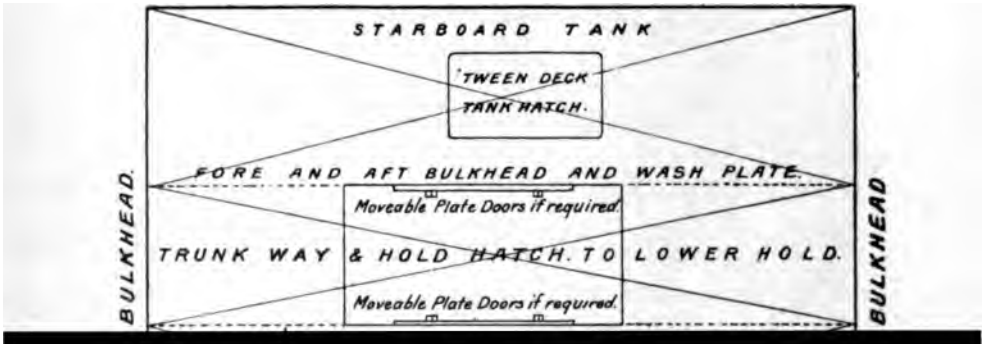
ballast, and consequent excessive racing of engines and the general unmanageableness of the vessels in not anwering their helms and falling off their courses into the trough of the sea—to say nothing of the great risk to life.

Ballasting ought to be a more prominent feature in the design of the tramp steamer than it is at present, and the extra cost

involved would be so comparatively trifling as to be scarcely worth considering. But apparently, up to the present time, there are still vessels building of the following dimensions:—

(*a*) Length, B.P., 395 feet; beam, 48 feet; depth, moulded, 31 feet; Lloyds' highest class; total ballast tank capacity, 1,019



13 feet 6 inches aft, 8 feet 3 inches forward, mean draft 10 feet 10½ inches, tons per inch of immersion on this draft 37, distance

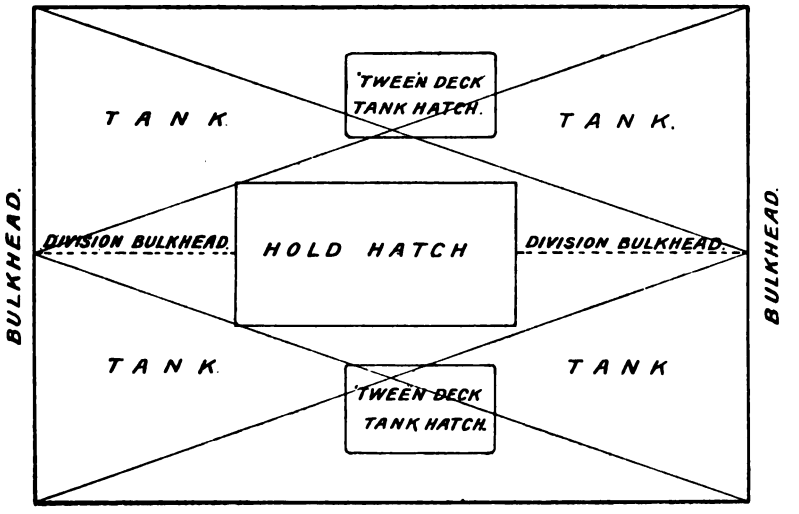



DIAGRAM No. 3.

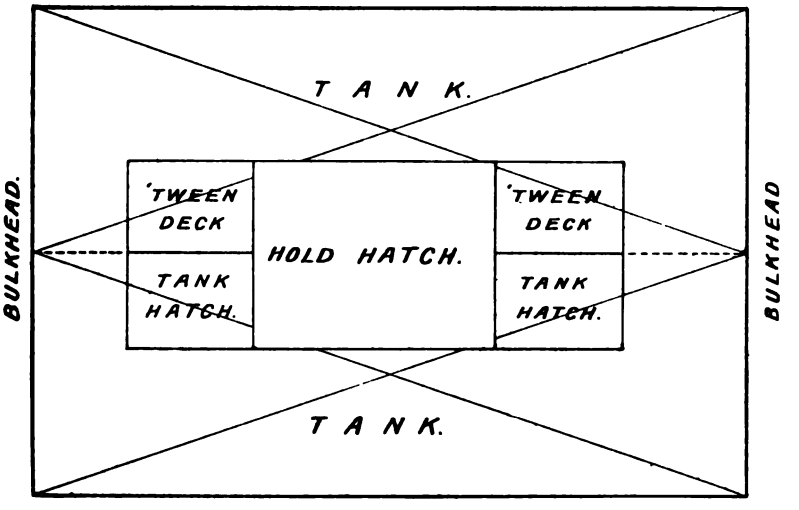



DIAGRAM No. 4.

from base line to centre line of shaft 10 feet 6 inches, diameter of propeller 17 feet 6 inches, vessel designed to carry over 7,000 tons.

(*b*) and (*c*) are two sister vessels. Length, B.P., 360 feet; beam, 48 feet; depth, moulded, 30 feet 10 inches; deadweight on 24 feet 6 inches, 7,000 tons; total ballast tank capacity, 896 tons; base line of ship to centre line of tail shaft, 10 feet 6 inches, diameter of shaft, 15 inches. From these figures it can easily be seen that these two vessels would not have the bosses of their propellers submerged when leaving a continental discharging port for a United Kingdom loading port fully equipped, stored, and with 200 or even 300 tons of bunker coals on board.

With figures like these it is no wonder we have continual breakdowns and unmanageable ships. To say the least it is a most unsatisfactory condition of affairs in regard to the ordinary tramp steamer of to-day. The following list of mishaps* which have occurred during the months of July, August, and September last has been copied from the "Syren" for your serious consideration, and in conclusion the writer would recommend any member who is interested in the subject, and who has not already done so, to read the very excellent article on ballast in Mr. T. Walton's book entitled "Know Your Own Ship."

The PRESIDENT—The discussion on Mr. Chaston's paper will be taken at our next meeting. Some of my shipbuilding friends will, I am sure, be very pleased to know that an engineer has at last found out the reason why tail shafts break.

The meeting then terminated.

JULY.—1901.

| Steamer's Name. | Gross Tonnage | Nationality. | When Built. | Class. | Cargo. | Voyage, etc. | Damage. |
|---|---|---|---|---|---|---|---|
| Bhadra ... ... ... | 599 | Br | 1897 | Lloyd's | — | Arrived at Colombo ... ... | Propeller lost. |
| Guernsey ... ... ... | 4,375 | Nor | 1898 | Lloyd's | — | Muroran to Vancouver ... ... | Tail shaft broken, propeller lost. |
| Earnwood ... ... | 2,158 | Br | 1881 | Lloyd's | Ore | Towed into Bilbao ... ... | Propeller shaft broken. |
| Fürst Bismarck ... .. | 8,430 | Ger | 1890 | V | General | Cuxhaven to New York ... | Main crank shaft broken. |
| Perim ... ... ... | 1,348 | Br | 1877 | Lloyd's | General | London to Alexandria ... ... | Crank shaft broken. |
| Mitylene ... ... ... | 2,478 | Grk | 1891 | Lloyd's | Timber | Genoa to Taganrog ... ... | Shaft broken. |
| Teutonia ... ... ... | 3,209 | Dut | 1892 | Lloyd's | General | Rotterdam to Boston ... ... | Tail-end shaft broken. |
| Ernest Simons ... .. | 4,562 | Fr | 1893 | — | General | Marseilles to Yokohama ... | Shaft broken. |
| Virawa ... ... ... | 3,333 | Br | 1890 | — | General | Towed into Calcutta ... ... | Shaft broken. |
| Hogarth ... ... ... | 2,053 | Br | 1882 | — | General | New York to Manchester ... | Crank shaft broken, propeller lost. |
| Titania ... ... ... | 3,430 | Br | 1895 | Lloyd's | — | Buenos Ayres to London ... | Tail shaft broken, propeller lost. |
| Forest Brook ... ... | 2,698 | Br | 1895 | — | General | New York to Hamburg ... | Tail-end shaft and propeller lost. |
| Marian ... ... ... | 1,936 | Br | 1889 | Lloyd's | Ballast | Barcelona to Quebec ... ... | Crank shaft broken. |
| Gabo ... ... ... | 2,060 | Br | 1883 | Lloyd's | — | Newcastle to Adelaide ... ... | Thrust shaft broken. |

AUGUST.—1901.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lennox ... ... ... | 2,361 | USA | 1895 | — | Transport | Manila to San Francisco ... | Tail shaft broken. |
| Mexico ... ... ... | 976 | Mex | 1874 | — | — | Vancouver to St. Michael's ... | Thrust shaft broken. |
| Buffalo ... ... ... | 4,431 | Br | 1885 | — | General | New York to Hull ... ... | Shaft broken. |
| Samoa ... ... .. | 1,101 | USA | 1875 | — | Transport | Manila to Seattle ... ... | Shaft broken. |
| na ... ... .. | 1,311 | Br | 1884 | Lloyd's | General | Copenhagen to Leith ... .. | Thrust shaft broken. |
| Apollo ... ... ... | 634 | Ger | 1883 | G.V. | Salt and wood | Lisbon to Bremen ... ... | Propeller lost. |
| Rotomahana ... ... | 1,763 | Br | 1879 | Lloyd's | — | Thames to Coromandel ... | Shaft broken. |
| Roehampton ... ... | 2,143 | Br | 1882 | Lloyd's | Coals | Cardiff to Azores ... ... | Crank shaft broken. |
| tin ... ... ... | 552 | Br | 1873 | — | — | Off Flamborough Head ... | Propeller lost. |

Steamers under 500 tons not listed.

SEPTEMBER.—1901.

| tion-ality. | When Built. | Class. | Cargo. | Voyage, etc. | Damage. |
|---|---|---|---|---|---|
| ·er | 1881 | V | General | St. Thomas to Havre ... ... | Propeller lost. |
| tal | 1881 | I | General | Naples to New York ... ... | Propeller lost. |
| Br | 1896 | Lloyd's | — | Towed into Sourabaya ... ... | Propeller shaft broken. |
| Br | 1883 | — | — | Freemantle to Melbourne ... | Tail shaft broken. |
| Nor | 1890 | N | Ballast | At Mobile ... .. ... | Shaft broken, propeller lost. |
| Br | 1892 | Lloyd's | — | Rotterdam to Blyth ... ... | Propeller lost. |
| Br | 1897 | — | — | Barrow to Douglas ... ... | Tail shaft broken. |
| USA | 1873 | — | — | Towed into San Francisco ... | Main shaft broken. |
| Br | 1890 | Lloyd's | — | Boston to New York ... ... | Tail shaft broken. |
| ·er | 1883 | G | Coal | Newcastle to Riga ... ... | Propeller shaft broken. |
| us | 1899 | Lloyd's | — | Liverpool to Buenos Ayres ... | Screw shaft broken. |
| an | 1889 | Lloyd's | Coal | Methil to Cronstadt ... ... | Shaft broken. |
| ·us | 1863 | G | Ballast | Towed into Copenhagen ... | Propeller lost. |
| us | 1892 | Lloyd's | Grain | Patras to London ... ... | Propeller lost. |
| Br | 1892 | Lloyd's | — | Sourabaya to United States ... | Shaft broken. |
| Br | 1897 | Lloyd's | — | Albany to Newcastle (N.S.W.) | Tail shaft broken, propeller lost. |

Steamers under 500 tons not listed.

# NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

EIGHTEENTH SESSION, 1901-1902.

## PROCEEDINGS.

THIRD GENERAL MEETING OF THE SESSION, HELD IN THE LECTURE HALL OF THE LITERARY AND PHILOSOPHICAL SOCIETY, NEWCASTLE-UPON-TYNE, ON FRIDAY EVENING, JANUARY 24TH, 1902.

HENRY WITHY, ESQ., J.P., PRESIDENT, IN THE CHAIR.

The SECRETARY read the minutes of the previous meeting, held in Sunderland on the 13th of December, 1901, which were approved by the members present and signed by the President.

The ballot for new members having been taken, the President appointed Mr. G. D. Weir and Mr. W. G. Spence to examine the voting papers, and the following gentlemen were declared elected:—

MEMBERS.

Humphreys, George, Supt. Engineer, c/o Messrs. Beckingham & Co., King Street, Newcastle-upon-Tyne.

MacMillan, H. M., B.Sc., Ship Draughtsman, 58, Fern Avenue, Jesmond, Newcastle-upon-Tyne.

Patterson, Thomas Henry, Shipbuilder, 2, The Elms, Sunderland.

Roxburgh, Allan B., Engineer, Whalley House, Esplanade Place, Whitley Bay.

Sinclair, Charles E., Consulting Engineer, 18, James Street, Liverpool.

## GRADUATES TO MEMBERS.

Agar, Alfred, E. Draughtsman, 3, Nut Grove, North Parade, Belfast.

Lee, Hugh Warren, Engineer, 88, Manor House Road, Jesmond, Newcastle-upon-Tyne.

Melville, James, Marine Engineer, Duke Street, Barrow-in-Furness.

Rappaport, Fred. G., Engineer, Messrs. Russian Petroleum and Liquid Fuel Co., Baku, South Russia.

Robinson, Francis, Marine Engineer, The Vicarage, Willington Quay-on-Tyne.

Tsimenis, Andrew, Naval Architect, Durham College of Science, Newcastle-upon-Tyne.

## ASSOCIATE.

Ramsay, Norman F., Brassfounder, 20, Sanderson Road, Newcastle-upon-Tyne.

## GRADUATES.

Cuttle, Henry H. H. (18), App. Engineer, 93, Coatsworth Road, Gateshead-on-Tyne.

Fortune, Thos. C. (20), E. Draughtsman, 76, Falmouth Road, Heaton, Newcastle-upon-Tyne.

Green, Fred. Wm. (16), E. Draughtsman, 4, Belle Grove Place, Newcastle-upon-Tyne.

Heck, William D. (20), App. Engineer, 10, Bristol Terrace, Newcastle-upon-Tyne.

Leitch, George A. (20), App. Engineer, 4, Akenside Terrace, Newcastle-upon-Tyne.

Watson, John G. B. (21), S. Draughtsman, 5, Nesham Street, Newcastle-upon-Tyne.

## MR. LITTLEDALE'S REPLY TO THE DISCUSSION ON HIS PAPER ON "THE SPEED OF MACHINE SHOP TOOLS."

Mr. J. W. E. LITTLEDALE replied to the discussion on his paper on "The Speed of Machine Shop Tools." He said—Mr. Andrew, in his remarks on my paper, considers that I should have dwelt more fully on the subject of the use of compressed air, in its reference to machine shop tools. I must say that I agree fully with him that the use of compressed air machinery has come to the front and intends to stay in that position, an ally of no mean repute to electricity. Comment on the many advantages of this system of working machinery would, I fear, occupy too much of your time this evening. I shall only say that the safety, cleanliness, and portability of apparatus as well as the small amount of space occupied are some of the many advantages indigenous to this system and to it alone. The use of compressed air in drilling has these advantages, the power acts direct on to the machine and does not appreciably drop in transmission if the mains are in good repair, the rapidity with which you can drive your drill with such power behind it and the portability of the machine are well appreciated in shipyards as well as the machine shops. The use of pneumatic drilling machines enabled me to increase my speed of drills 30 per cent., as I had definite proof the drills would stand the strain. The only drawback is the shifting of the gear when holes were far apart. I need hardly add that the less complicated a machine is the better, as the unskilled hand can then clean it, which does away with the mechanic's time wage going on to the machine tools for upkeep.

The pneumatic rammer for foundry use, also the pneumatic brush for cleaning castings are not in their present stage favourites with me, but manufacturers will find the use of the pneumatic chipping or caulking hammers or rivetting to be well worthy of their extensive consideration, especially if they have large cast steel castings to deal with. I give h table

of the quantity of rivets fixed by the different types of rivetting hammer from notes taken in this locality, so I presume the statement cannot be parried.

| Time worked. | No. of Rivets. | Work. |
|---|---|---|
| 10 hours ... | 1,200 ... ... | Bridge work. |
| 10 hours ... | 250-300 ... | Beam knee and frame ends. |
| 10 hours ... | 1,000-1,200 .... | Deck. |

The decrease in numbers is plainly seen to be due to the inability of the men to go straight away with their work.

Comparison between pneumatic and hydraulic rivetting is a subject for the marine architect to discuss.

In the journal devoted to the use of and styled "Compressed Air" for March, 1901, there is a full and comprehensive list of the "speeds," air consumption and weight of four standard types of pneumatic hammer and the dimensions of the moving parts. The hammers taken are as follows:—

| Type of Hammer. | Speed in Blows per Minute. | Air in Cub. Ft. per Minute. | Weight in lbs. |
|---|---|---|---|
| Ross ... ... ... ... | 11,000 | 30 | 11½ |
| ,, ... ... ... ... | 11,000 | 25 | 10¾ |
| ,, ... ... ... ... | 11,000 | 18 | 10½ |
| ,, ... ... ... .. | 11,000 | 15 | 6½ |
| ,, ... ... ... .. | 11,000 | 13 | 6 |
| Q. and C. Single Hammer | — | 12 | 5¾ |
| | 10,000 | 12 | 5½ |
| | to | 10 | 3½ |
| Q. and C. Double Hammer | | 18 | 10¾ |
| | 15,000 | 15 | 9¼ |
| Little Giant ... ... ... | 1,200 | 20 | 16 |
| | 1,500 | 15 | 12 |
| | 2,000 | 15 | 9½ |
| | 2,000 | 15 | 8½ |
| Boyer ... ... .. ... | 1,000 | 20 | 26 |
| ,, ... ... ... ... | 1,800 | 20 | 13 |

[redacted]

area of instruction the individual subject suffers. Yet I still maintain that where there is mechanical instruction given in the engineering laboratories as it very often is, there would be time and most instructive as well as genial employment for the junior members of such classes to experiment on tool steel, systems of gearing, driving of, and feeds and speeds of the ordinary lathe; instead of turning or shaping test pieces at a kill time pace, which is only conducive to laziness. In reference to his remarks on my tables of speed, I admit they seem low, but am sorry to say they were the average at which the majority of machines are worked and not the maximum attainable or adopted on one or two.

Mr. Paulin's remarks are both interesting and instructive, and I am indebted to him for some valuable suggestions. In reply to his query relative to independent feeds for milling machines I have not had much practical experience in the adoption of this plan as yet, also I can assure him that the high rate of speed in test A was not the second cut but a roughing cut in every case. I tried to break down the tool sample and subject it to the severest possible test.

I attach here the information required by Mr. Bennett *re* the price of the material in tool steel.

| | | | | | |
|---|---|---|---|---|---|
| A | ... | ... | ... | 2s. 0d. | per lb. |
| B | ... | ... | ... | 1s. 10d. | ,, |
| C | ... | ... | ... | 0s. 9d. | ,, |

I thank Mr. Hollis for his suggestions, but I hope he does not consider that I should have dwelt in full on all the subjects he gives. What about one for instance—the transmission of power. Admitting that there is a great deal omitted, yet I consider a general outline of the minor details gives more scope for criticism and discussion for mutual benefit than a long dissertation on mathematical deductions correctly arrived at. In reference to the remarks at the end of his notes, I may say that I have lived a few years in the United States and Canada, and have seen this advertisement in large letters over a shop selling joiners' tools and all kinds of steel ware:—"We keep only English manufactured goods, what better can you get?" Also that of the four pocket knives I had I disposed of three at 200 per cent. profit owing to the Sheffield trade mark being on

them. Also if you refer to Mr. R. J. J. Swan's "Random Notes in the United States," produced in "Engineering" of December 27th, he remarks that English steelmakers seem to have nearly a monopoly of the American tool steel market. The only criticism I heard derogatory to British manufacture was the time taken in filling our contracts.

Mr. Wm. Thompson's remarks are very much to the point when he refers to the shops being well lighted and warmed, it makes this difference that good men will try and keep their situations in comfortable shops. Mr. Thompson asks for data in reference to my remarks on the position of tools either inverted or otherwise, I can only say I have frequently tried this and found it as I stated. I have known a man slotting a commutator of over 160 sections save 3 hours on the second half by being put on the premium system.

The PRESIDENT—I have to propose that a most hearty vote of thanks be given to Mr. Littledale for his paper. It was a very interesting paper; the discussion was also interesting, and I think the reply was perhaps more interesting than either.

The motion was carried by acclamation.

## DISCUSSION ON MR. E. C. CHASTON'S PAPER ON "THE BALLASTING OF MODERN TRAMP STEAMERS."

The PRESIDENT—Our next business is the discussion on Mr. E. C. Chaston's paper on "The Ballasting of Modern Tramp Steamers." By way of a commencement I have called Mr. Chaston's attention to his list of 39 steamers. His paper deals specially with ships in ballast, but if you look at his paper you will see many mentioned in the list are apparently loaded ships. Under the heading of "cargo," we have ore, general, timber, and so on. Then we come to "ballast," and I think there are only three or four in ballast. I have called Mr. Chaston's attention to that point, and no doubt he will be dealing with it in his reply. Generally, I was much interested in the paper, and was very pleased to find that it was not the weakness of the ship, as I said at last meeting, that caused all the broken tail shafts.

Mr. W. R. LORD said—The important question of not giving sufficient ballast to modern cargo steamers is one that should very properly command the attention not only of those who have to navigate them, but that of shipowners, and underwriters alike. The ably written paper by Mr. Chaston gives the reader a very good grasp of this important subject. *The effect of not having sufficient ballast.* My own experience as a commander has given me ample proof that steamers of to-day go to sea seriously handicapped for the want of sufficient ballast. As evidence of this the master of a ship who properly appreciates his responsibilities in safeguarding the property and lives under his care will seriously hesitate before venturing to approach a lee shore, or place his ship in a position from which she cannot be easily extricated. I regret to say that many steamers of recent construction prove themselves to be quite unmanageable, even in a strong breeze. It can therefore be imagined what they are like in a heavy gale. This is not to be wondered at when it is considered that they have such a slight

hold of the water, particularly towards the end of a voyage, when their bunkers are nearly empty. On these occasions they fall off into the trough of the sea, and wallop about most unmercifully. It is needless to say that under such circumstances they are quite beyond control. I have heard of several instances of steamers driving broadside on to the shore, and thus becoming total wrecks from the causes which I have assigned. In these cases the person that is blamed by the Board of Trade is the unfortunate master, for they claim that his experience should teach him to know when a ship is in a seaworthy condition, and when she is not. Therefore, if he has had the good fortune to be saved, his position is not a happy one, for the reason that a court of enquiry will assuredly investigate the matter, and if it is found that he had not taken the precaution to ballast his ship, he is punished for his delinquency by having his certificate suspended. Whereas on the other hand, if he acts as his judgment dictates and goes to the expense of providing sufficient ballast for his vessel, he stands the best of chances of being superseded in his command at the termination of the voyage. It can, therefore, be seen that the poor man is in the unenviable position of being between the devil and the deep sea. In this connection it may be mentioned that there is another danger to which an under-ballasted ship is subjected, that is, the possibility of having her bottom knocked in whilst pounding on the heavy seas that may be encountered. As a matter of fact I have heard of several steamers arriving in American ports with serious damage contracted in this way, and when the actual damage has been disclosed it has been a subject for surprise that they have kept afloat until they arrived in port. *As to the best means of ballast-*

tanks generally, I am strongly in favour of having a longitudinal division between them, which not only adds to their strength, but eases the pressure when a ship is rolling heavily. It is further an effective means of trimming a ship if she should have the misfortune to shift her cargo. There is no doubt but that many steamers would have been saved from capsizing if the ballast tanks had been arranged in this way. *What would be the extra cost of constructing deep tanks?* From enquiries, I find that for ordinary large sized ships it would work out to about one pound (£1) per ton carried, or in other words, if it is desired to have tanks carrying, say, 1,000 tons it would then be necessary to add £1,000 to the ordinary cost of construction. From an economic point of view I have no doubt but that this outlay would be recovered by shortened passages and reduction in wear and tear, particularly in the Atlantic trade. This is apart from the question of reduced coal consumption and portage bills. *What is the cause of shafts breaking?*—This is attributed by Mr. Chaston to the fact of ships being insufficiently ballasted, at least in three-fourths of the cases. That it is one of the factors leading to these accidents I have no doubt, but if we look at the records produced in the "Syren and Shipping" for January 1st we will see that out of 140 cases cited only 24 are stated to have been in ballast. This fact points to some other cause than that ascribed, and is, therefore, a matter that deserves the closest attention. Looking at this question from another standpoint, may not this accumulation of accidents be due to general structural weakness? I have noticed since the introduction of steel in the building of ships that they have been much less rigid, and have proved more flexible in a heavy sea than was the case with the older ships. *An under load line.*—It is well known that this question has commanded the attention of nautical men, and others, for some time, and its importance was deemed to be such that a Bill dealing with the subject was introduced in the House of Lords last session by Lord Muskerry. In debate it was pointed out that a measure of such far-reaching consequences would seriously handicap British commerce. Therefore on its second reading being reached it was strenuously opposed by the Earl of Dudley, who represented the Board of Trade. There is no doubt, however, but that the question will be revived at some future date, with what result time only can tell. *How to arrive at the best means of meeting*

*the difficulty?*—In view of the great importance of this question, and to show that the introduction of this paper has demanded that practical attention which the subject deserves, would it not be as well to formulate some scheme showing in which way the proper ballasting of ships could be accomplished, and thus prove to shipowners that the extra cost of doing so would be an eventual economy. If this could be done, and shipowners induced to look at it from such a standpoint, you may depend upon it that there would be no need for legislation on the matter, and that all sections of those interested in our merchant navy would be satisfied.

No other members present wishing to speak,

The PRESIDENT said—I do not want to close the discussion yet. I think we had better adjourn it until the next meeting.

The discussion was adjourned.

# SOME NOTES ON STEAM TURBINES.

By F. J. WARBURTON.

[Read before the Institution in Newcastle-upon-Tyne, on January 24th, 1902.]

I do not think there can be any doubt that the first engineer who saw a jet of steam flowing from a pipe tried to blow some sort of wheel round with it, and, although this must have happened at least three thousand years ago, the problem of obtaining rotary motion from the direct impulse of steam continues to have an irresistible fascination for the mechanical engineer.

There are, I believe, some three ways of utilising steam for the transformation of heat into useful work.

In historical sequence, firstly, by directing a jet of steam on to movable objects, such as the blades of fans, or, in reaction wheels, by allowing the steam passage itself to revolve.

Secondly, by condensing steam in a cylinder, and allowing the external atmospheric pressure to force a piston inwards (Newcomen's engine).

Thirdly, by cutting off slices of high pressure steam, and expanding in the cylinders of the modern reciprocating engine.

The steam turbine designer, however, is merely concerned with the first and oldest method.

A perfect gas, according to the kinetic theory enunciated by Bernouilli, Joule, Tyndall and others, consists of a number of molecules, equal in size and weight, moving in straight lines and bombarding the boundaries of the space they occupy. Dry hot steam is found to behave as a perfect gas, and is considered as such in this paper.

The simplest possible steam impulse turbine must consist essentially of a fixed nozzle guiding a jet of steam on to vanes

arranged at the periphery of a rotating wheel in a very similar way to the buckets of the well-known Pelton water wheel; but to turn this wheel efficiently it is necessary not only to make the nozzle of suitable dimensions and shape for the work to be done, but to form the vanes or buckets of the wheel so that they make the best possible use of the steam as delivered from the nozzle.

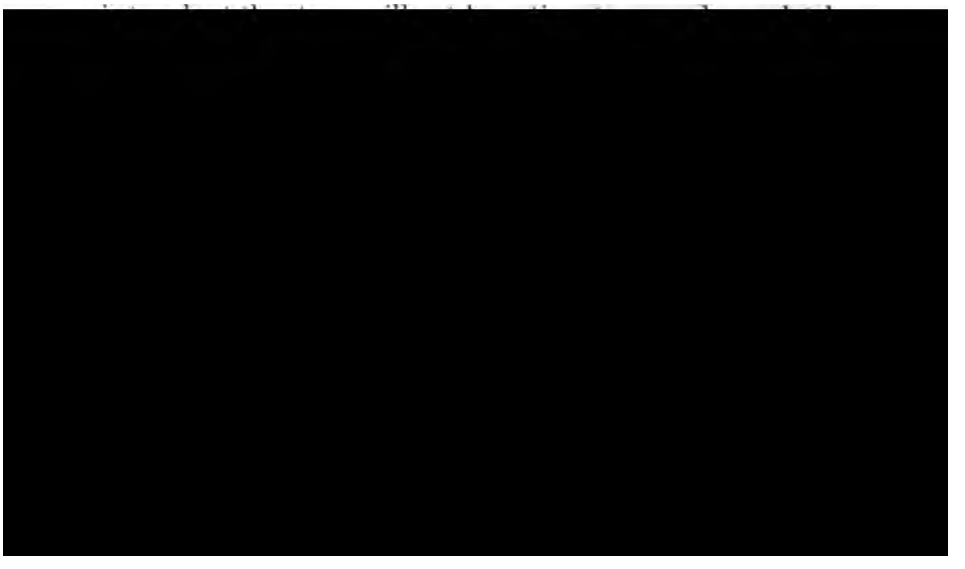
The function of the nozzle is to convert the whole available energy of the steam into mass X velocity in the required direction. It should therefore be designed so as to expand the steam to the same pressure as that of the wheel chamber before delivery on to the vanes. If the nozzle is improperly formed, either the expansion will not be complete and the jet will burst into a cloud at the orifice, or eddy currents will be set up within the nozzle itself, and retardation of flow will be the result.

To arrive at the best shape of steam nozzle, the ratio of expansion required should be first decided, and the area of entrance, A in Fig. 2, Plate V., should bear a relation to the orifice B in direct proportion to the increased volume of steam when expanded.

The curve of nozzle walls is calculated to allow gradual expansion, until maximum velocity, due to initial pressure energy, is attained.

Fig. 1, Plate V., shows an example of what is found to take place in an incorrectly shaped nozzle. The steam particles rebound from the walls as shown by the dotted lines, and meeting at *a*, *a*, *a*, *a*, form points of greatest pressure.

Turning again to Fig. 2, Plate V., if the length C is too great there will be retardation of flow due to the skin friction, and if C



The most efficient mean speed of vanes is just under half the velocity of the steam current, thus leaving the exhausted molecules relatively motionless.

For this reason single disc turbines must revolve at enormous speed and be geared down for driving ordinary machinery. For example, a 10 inches De Laval turbine working at 70 pounds pressure revolves 14,000 times per minute.

Geared motors are avoided like the plague by most engineers, and so the multiple step steam turbine was devised as a means for reducing the speed of rotation and driving machinery direct. This idea was first developed into a marketable commodity by Parsons during 1884-7.

The earliest Parsons parallel flow turbine was a collection of zig-zag nozzles whose walls were formed by projecting rings of blades intermeshing, and so arranged that the "zigs" were fixed to the inner circumference of a stationary hollow cylinder and the "zags" to the outer circumference of a rotatable cylinder. The modern Parsons turbines from which such notably economical steaming results have been obtained differ from the earliest (apart from improvements in mechanical and constructional detail) only in the alteration of the contour of the steam passages or nozzles from a zig-zag to a sinuous shape. Instead of turning sharp corners the steam now traverses flowing curves, and the cross sectional area of steam channels increases in nearly exact proportion to the growing volume of steam as it expands to the exhaust pressure, the collective areas at each stage fulfilling more closely the conditions for a perfect nozzle as previously mentioned. But as expansion takes place both within fixed and moving blades, as the whole passage is one continuous nozzle, the clearances and workmanship must be of the finest to minimise leakage, which in the earlier machines was a serious trouble.

Professor Curtis, of New York, has designed large steam turbines which follow Parsons very closely in theory, but are differently worked out mechanically.

Few revolving discs of comparatively large diameter are arranged and the fixed steam nozzles only play upon part of their periphery, in some cases only two nozzles being employed on the first disc. Provision is made for altering the nozzle areas according to load by opening or closing their tapered walls, thus

to a certain extent permitting correct maintenance of expansion ratios for varying steam pressures and loads.

Professor Curtis argues that his arrangement of few large nozzles and wheels in series lessens the percentage of waste through spilling of steam.

In order to reduce the revolutions per minute as far as possible Mr. Parsons appears to advocate a large number of turbines in series of small diameter, while Professor Curtis believes in few wheels of large diameter. Apart from relative economy in steam consumption, the former appears to lend itself best to considerations of weight and space, and the latter to cheapness and simplicity of construction.

Professor A. Rateau, in conjunction with Messrs. Sautter, Harlé & Co., of Paris, has worked out a multiple step impulse steam turbine consisting of a number of Pelton or Laval wheels, with helicoid vanes, arranged in series on a shaft, each wheel revolving in a separate chamber. Distributing nozzles convey the steam to the wheel vanes and the whole of the expansion is accomplished within the fixed nozzles. The steam leaves the chambers at almost the same pressure at which it entered, the wheel vanes merely receiving the impulse due to the velocity of its particles; there is therefore in this case no tendency to leakage and no necessity for fine fits or clearance. A machine of this type has been built of 1,200 B.H.P., and one is now in hand of 1,800 B.H.P., from which a steam consumption of 12½ pounds B.H.P. per hour is expected.

The multiple expansion steam turbine shown in Fig. 4, Plate VI., was designed and made for experimental purposes some three years ago, and since that time has been carefully tested under various conditions, the object of the research being to collect a set

are cut into the inner faces of these wheels, and the walls of the cells form curved vanes. Each wheel revolves in a separate chamber. Steam at 75 pounds' pressure absolute is admitted to the centre chamber B (which contains no wheel) and is thence conducted to the vanes of the first wheel by four diagonal nozzles pierced through the partition C. These nozzles are shown in the ½ cross section X, X (Fig. 5, Plate VII.), and also in the developed section of nozzles and wheel. The curved vanes as nearly as possible reverse the direction of the jet, and the steam being passed over the outer periphery remains comparatively motionless in chamber 1. Similar but slightly large nozzles guide the steam on to the wheel in chamber 2, and so on until No. 7 is reached, when a passage, D, of ample area conducts the flow to chamber No. 7 A, which, like chamber B, contains no wheel. It should here be noted that partition E is blank. From No. 7 A to No. 14 the steam expands by equal steps to the exhaust F, the collective nozzle areas being so arranged that each wheel does an equal share of work. Steam gauge connections to each chamber were provided and the pressure differences recorded. Each nozzle in each partition was tapered and formed to comply with the conditions just mentioned as far as possible.

End packing and isolation of chambers was effected by means of floating packing rings of more or less L section.

These rings fitted well but freely on the shaft and were held against faces by the steam pressure. When running, it was found that they did not revolve with the shaft but remained stationary, floating on an extremely thin layer of steam between ring and shaft. No internal lubrication was necessary (an important point for condensers and boilers) and no wear was apparent on rings or shaft. A wheel, ring and partition plate which have been in use for some time are now on the table. This machine ran well at 5,000 R.P.M. and was very fairly economical in steam consumption, especially with super-heat.

The second machine shown on Fig. 6, Plate VIII., is a reversible motor. It reversed from 4,000 R.P.M ahead to 4,000 R.P.M. astern in five seconds, giving 75 per cent. power astern with the same steam pressure.

In this case two oppositely inclined sets of nozzles are pierced in each chamber wall, the "go ahead" set playing on the most efficient side of the wheel vanes.

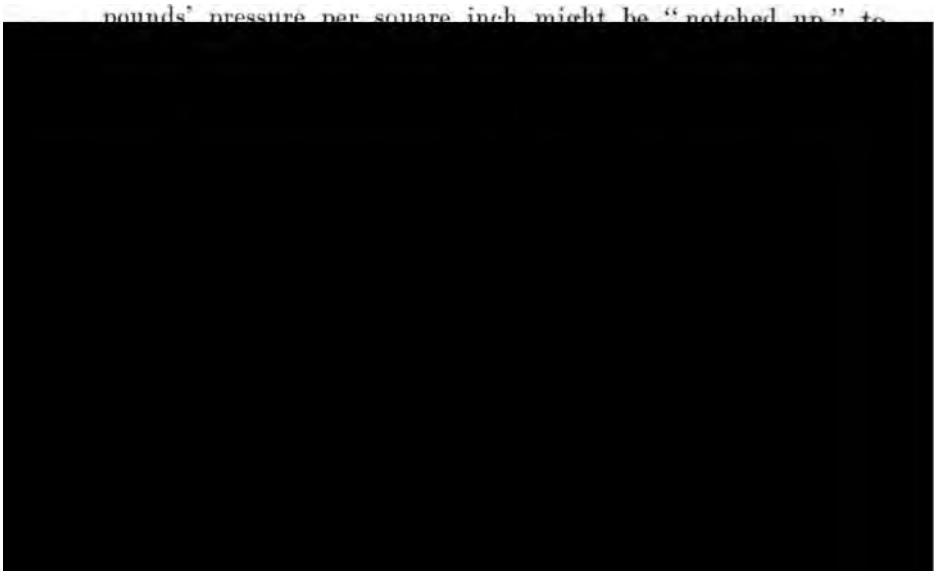
If equal reversing power were desired the astern nozzles might have some 25 per cent. more area. In front of each partition a very thin circular valve is arranged, containing ports corresponding to the nozzle entrances. These valves can be rotated through a small angle by means of a weigh shaft and lever. In the ½ cross section (Fig. 7, Plate IX.) the lever is shown with the valves in the "go ahead" position, the "go astern" ports being closed. When the valves are in the central position the small hole C is thrown open for draining and warming up purposes, also to prevent excessive accumulation of pressure in front to the first partition.

The last figure (Fig. 8, Plate X.) shows an arrangement of ball bearing which was used successfully up to 7,000 R.P.M. A is rubber which absorbs the small vibration and allows the shaft to rotate in its true centre of gyration, which hardly ever corresponds with its geometrical centre on account of small inaccuracies of balance. I do not, however, particularly recommend these for general use, as it is so difficult to get really hard steel balls and races.

The reversing valve mechanism described lends itself to modification.

The same valve might be utilised for closing one or more nozzles in each partition plate at pleasure, thus altering the collective nozzle areas in use, and by maintaining correct expansion ratios permit the turbine to work at different speeds and pressures at its highest economy. This would be an important consideration for torpedo boat destroyers, cruisers, and other vessels which make long runs at half or quarter power.

Thus the engines of a ship which worked full power at 200 pounds' pressure per square inch might be "notched up" to



# NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

EIGHTEENTH SESSION, 1901-1902.

## PROCEEDINGS.

### THE ANNUAL DINNER.

The annual Institution dinner was held in the Assembly Rooms, Westgate Road, Newcastle-upon-Tyne, on the evening of Thursday, January 30th, the President, Henry Withy, Esq., J.P., in the chair. The President was supported by Mr. Charles Dorman (Messrs. Dorman, Long & Co., Limited); Mr. J. R. Fletcher (Local President of the Institute of Civil Engineers); Ald. W. Boyd (Mayor of Wallsend), Mr. Wigham Richardson, and Sir Benjamin C. Browne (the three latter gentlemen being Past-Presidents of the North-East Coast Institution); Mr. W. Jamieson (Messrs. Dorman, Long & Co., Limited); Mr. John Gravell (Bureau Veritas); Mr. J. Robley (President of the Foremen Engineers Association); Fleet Engineer R. W. Edwards, R.N., Mr. J. R. Fothergill, Mr. H. Fownes, Mr. Summers Hunter, Mr. J. M. Rennoldson, Mr. A. G. Schaeffer (the five latter gentlemen being Vice-Presidents of the Institution); Mr. Roland Philipson, Mr. G. E. Macarthy (Hon. Treasurer), Mr. John Duckitt (Secretary) and others to the number of about 180.

The following invited guests were unable to attend:—The Mayor of Newcastle, the Sheriff of Newcastle, The Lord Bishop of Newcastle, the Earl of Durham, Bishop Hornley, Sir A. J. Durston, Mr. W. R. Plummer, M.P., Mr. G. Renwick, M.P., Principal Gurney (Durham College of Science), Mr. J. T. Milton (Lloyds Register), Mr. W. T. Courtier-Dutton (British Corporation Register), Mr. W. H. Panton (Messrs. Dorman, Long & Co.), Mr. Hugh Bell and Col. C. L. Bell (Messrs. Bell Brothers), the

President of the Institute of Naval Architects, the President of the Institute of Engineers and Shipbuilders in Scotland, the President of the Institute of Mechanical Engineers, the President of the Institute of Marine Engineers in London, Dr. Merz, Dr. T. Hodgkin, and Mr. B. Plummer (Secretary of Newcastle Chamber of Commerce).

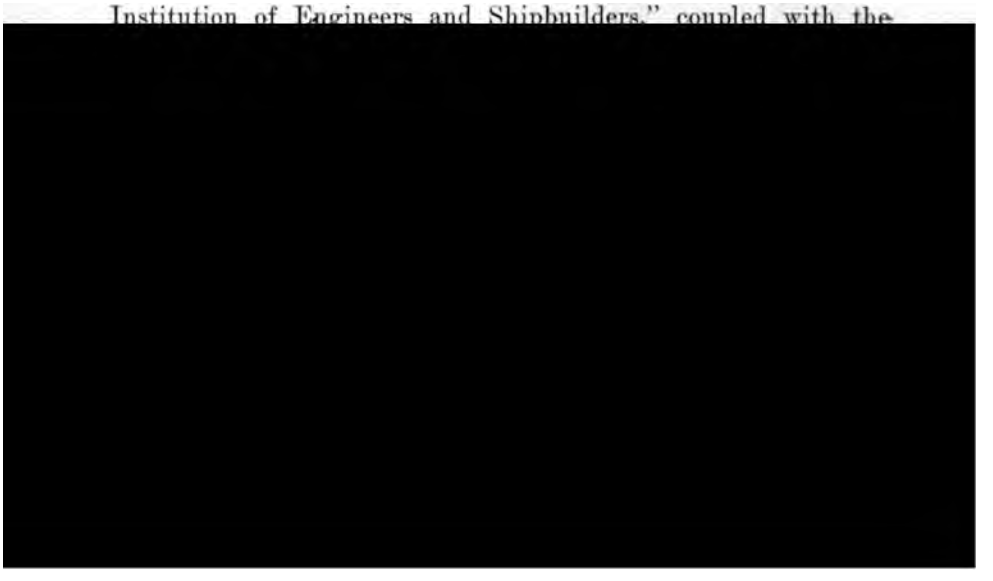
An excellent repast was purveyed by Messrs A. H. Higginbottom & Co., and during the evening Mr. Robert Smith's Royal Orchestra discoursed a very pleasing selection of music.

After dinner a short toast list was submitted.

The PRESIDENT said—Gentlemen,—It is my pleasing duty to give you the first toast of the evening, that of "His Most Gracious Majesty the King, Queen Alexandra, and the rest of the Royal Family." In a loyal and patriotic town like Newcastle it is not necessary for me to dilate upon the excellences of the King and the Royal Family. I will content myself with giving you the toast at once—"The King, the Queen and Royal Family."

The toast was loyally honoured.

Mr. CHARLES DORMAN said—Mr. President and gentlemen,—A great honour and a great pleasure devolves upon me to-night. I must admit at the same time it is tinged with a slight regret, perhaps with a great regret, that this honour has not fallen upon much abler shoulders than my own. The pleasant task I have to perform to-night is to propose the toast of "The North-East Coast Institution of Engineers and Shipbuilders," coupled with the



the whole world, that there is no need for me to say anything about him. In the summer time you did the Company of which I am a member the honour of looking over our works. I hope you will come again. The only fault I have to find with you is that you did not bring Mr. Withy with you on that occasion. I hope the next time you come you will bring him with you. Since you visited our works in the summer time the employers of labour in this country, owing to their reluctance to tackle two of the most interesting problems of the day, that is to say, labour and railway rates (and now I think about it I may say that if there are any friends or officials of the railway companies here, and the President tells me that the railway companies have no friends, but I do not believe him—if there are any of their friends here I do not wish anything I may say in the remarks I am going to make about the railway company to be taken amiss; I am simply guided by a desire, to the best of my ability, to repel the foreign invader from these shores as far as iron and steel manufacture is concerned),—well, since you came to our works in the summer time the employers of labour have been, gradually, one after the other, diving into some morass of depression. If they would only combine and help one another then they would be able to force their way through this morass with no other damage to themselves than a financial "wash and brush-up" to put matters right; but if they will not combine and help one another, then it will be many years before they finally emerge from this morass, and when they do emerge they will be in a terrible state of debility. They will be in a state of constitutional decay, and not only that, but they will be in a state of commercial decay. All these evils —labour especially, and railway rates—can be overcome by effective combination and resolution, and they will be overcome all the more readily if the employers of labour will realize that the railway directors, and the working men of this country are not the intractable and unapproachable ogres and barbarous monsters they are commonly supposed to be, but falsely supposed to be, in the popular estimation, but merely intelligent human beings. Mr. William Garret did me the honour of criticising some remarks I made in a speech to the officials and men of the firm of Dorman, Long & Co. in December last when they very kindly entertained me to a dinner after my return from the United States of America. The remark he chiefly caught on to was that in America the

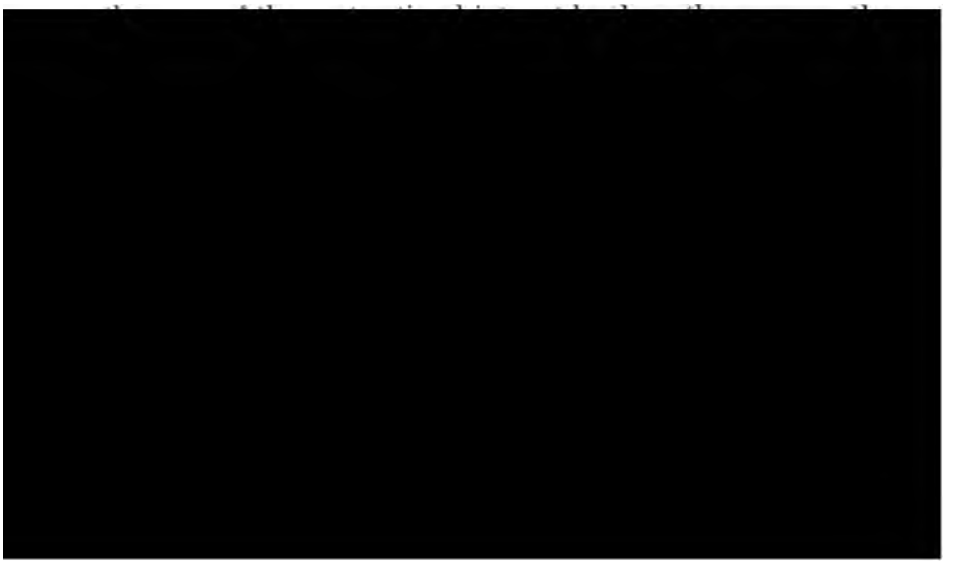
working men are more intelligent than they are in England, from which, he said, he entirely disagreed. Then he went on to say that in America he found the best workmen to be the Englishmen. What I wish to point out to Mr. Garret is that an Englishman in America and an English working man in England are two very different people. In America an English working man has every inducement offered him to bring into play that keen intelligence with which every Englishman is born—the conditions there are entirely different—whereas in England he is only too apt to allow that quality to lie dormant under the fostering care of some union or other which does not encourage individual merit. That was the meaning I intended my remark about intelligence to bear. I myself have no quarrel with the British working man. I know the British working man, and I know him to be a thoroughly good fellow, and the sooner employers of labour in this country realize that fact, and the sooner unions cease to discourage individual merit the sooner shall we arrive at that stage of co-operation between masters and men, without which works cannot be satisfactorily conducted. This combination will be equally effective in dealing with railway companies. I do not know whether many of you gentlemen have been reading, of late, a paper called *The Statist*, but during the last few months *The Statist* has published a series of articles about the big English railway companies, and if you have read it you will have seen, according to the figures they publish, that the North-Eastern Railway charge 29 per cent. more per ton per mile for their mineral rates than do any other railway company. Not only this, but they charge less for their passenger traffic than do any other railway company. I do not object at all to low passenger rates—in fact, I admit they are a great blessing to the public—but if we in this district are to have

to you about means on the cost of pig iron at least 2s. 6d. a ton, and 2s. 6d. a ton means a great thing to engineers and shipbuilders. You must admit that although engineers and shipbuilders are very superior people, yet they have to deal with iron and steel. If you ask me why it is that the people chiefly interested in this matter have not taken it up before—the people chiefly interested are the colliery owners, the mine owners, the blast-furnace owners and the owners of steel rolling mills—the only reason I can assign is that in the past they have been too prosperous; they have been too large-hearted; they have not minded. They have rested in a state of lethargic ease. I have a kind of recollection of reading in the Bible about the people of some tribe who "waxed fat and kicked." Well, the blast-furnace owners have certainly waxed fat in the past, but they have not yet kicked. But when they do kick, although their evolutions may not be particularly graceful, they will be quite effective. At present they prefer to adopt the rôle of the Sleeping Beauty. They are waiting for the awakening kiss of some bold prince. When this prince does come I am convinced he will be either an engineering or a shipbuilding prince. Perhaps he may come from Newcastle. Well, gentlemen, prince or no prince, we all of us must combine and try to induce the railway company to reduce their mineral rates, which at the present moment are so exorbitant. I feel satisfied that if we approached the company in a proper way the directors would see fit to reduce their rates to those charged by other companies, and that is all I ask they should do. But should they not do so, then we must take counsel with one another as to what we should do. We have a precedent to fall back upon. Once upon a time, about 250 years ago, there lived a man who, like the railway company, was a great power in the land. His name was King Charles the First. He, also, like the railway company, charged exorbitant rates. They were not railway rates, but they were tonnage and poundage rates. And the people asked him to reduce these charges, but he would not, so they combined together and they cut off his head. I do not wish to complete the parable. I hope it will be unnecessary for me to take any such tragic steps. I am convinced the railway directors are too magnanimous to render that necessary, but we must see that our axe is sharp—an axe wrought by pious determination and just reason, for the railway company have a stiff neck and the operation of severance might

be more exhausting than it was in the case of that other extortionate magnate. If this country has made up its mind to do a thing nothing will stop it—not even railway companies. Every obstacle will be swept to one side or the other and railway companies will find it is more to their advantage to fall in with the van than to follow in the ruck whilst the nation marches to commercial victory. As you all know, in the years 1897 and 1898 the North-East Coast Engineers saved themselves, to their immortal glory, by their own example. I only hope in 1902 they will save the rest of England by their example. Gentlemen, I give you the toast of "The North-East Coast Institution of Engineers and Shipbuilders," coupled with the name of the President, Mr. Withy.

The toast was cordially honoured, three cheers being given for the Institution.

The PRESIDENT, who was received with cheering on rising to respond, said—Mr. Dorman and gentlemen,—It is a proud privilege of mine to reply this evening on behalf of the North-East Coast Institution. I must thank Mr. Dorman for his all too flattering remarks. The Institution which I have the honour to preside over is one that embraces those engaged in practically all the trades in connection with engineering and shipbuilding. We have members from the extreme south to the extreme north and from east and west and from foreign parts as well. The *Transactions* of our Institution are getting more valuable year by year, and I feel convinced that the papers that we have before us in our records will be valued for a long time to come. Perhaps



other excursions of a similar nature this year. The Institution of Mechanical Engineers propose to hold their summer meeting in Newcastle this year, and I am sure Newcastle will elect a representative committee who will give them a very hearty welcome, and certainly our Institution must be well represented upon that committee. As an Institution we have been in existence since 1884. Eight Presidents have preceded me, and I am exceedingly glad to say that all our Past-Presidents are yet living and well. Although we are an Institution only eighteen years old I think we may congratulate ourselves upon that point. I would also like to congratulate your friend and my friend Mr. Robert Thompson, one of our Past-Presidents, on being elected to sit on Lloyds Committee. He has sat on the sub-committee for a number of years—twelve years I think—and I am sure his elevation to the General Committee will meet with everybody's approval. Mr. Dorman has given us his views upon railway rates. I can heartily endorse what he says. Any reduction we can get from the railway company we are most delighted to take. We all feel that; but I want to speak rather about steamers. I was looking through a report of the number of passengers carried on various steamship lines, and I was very much surprised to find that the North German Lloyd and the Hamburg-America Companies each carried nearly twice as many passengers as the White Star line. This is due partly to the speed of the new ships and partly to the geographical position of Germany; but taking the first and second class passengers only, the number carried by the White Star line is very nearly the same as the number carried by the Hamburg-America line and the North German Lloyd, although the sailings of the two latter lines greatly exceed the White Star sailings. If we take the first saloon only the average number of passengers carried out and home by the White Star line is 162 per trip, for the Hamburg-America line 116 and the North German Lloyd 115 per trip. These figures shew that the White Star boats are very popular. I think it has been proved that the running of these very large and fast steamers is not entirely a commercial success, and I think it behoves our government to consider very seriously whether it is not their duty to subsidize to a certain extent some of the larger companies so that they may run faster steamers than are now running on the Atlantic service. You will know that the govern-

ment have a claim upon certain of the faster steamers that are running to be used as armed cruisers. Now if these boats running twenty and twenty-one knots are used as armed cruisers, of what value are they against boats that can cross the Atlantic at twenty-three knots, and do it regularly, voyage after voyage? I think we ought to have a service of large steamers running at least twenty-four knots, all of them fit to be used as armed cruisers, and that whatever subsidy is necessary to enable the companies to do this should be cheerfully paid out of the Imperial revenue. I do not want to detain you longer, because I feel sure you appreciate very much the privilege of leaving your seats and going about the room and talking to your friends; but I want to impress upon the younger members of the Institution that the future success of the Institution depends more upon them than it does upon those who are not, perhaps, quite into "the sere and yellow leaf," but who have passed the middle age. We as an Institution feel the graduate section is one that deserves every encouragement, and we hope the younger members will be assiduous in reading papers and paying attention to the development of the Institution. If the younger members do not do this the Institution must fail. I thank you very much, gentlemen.

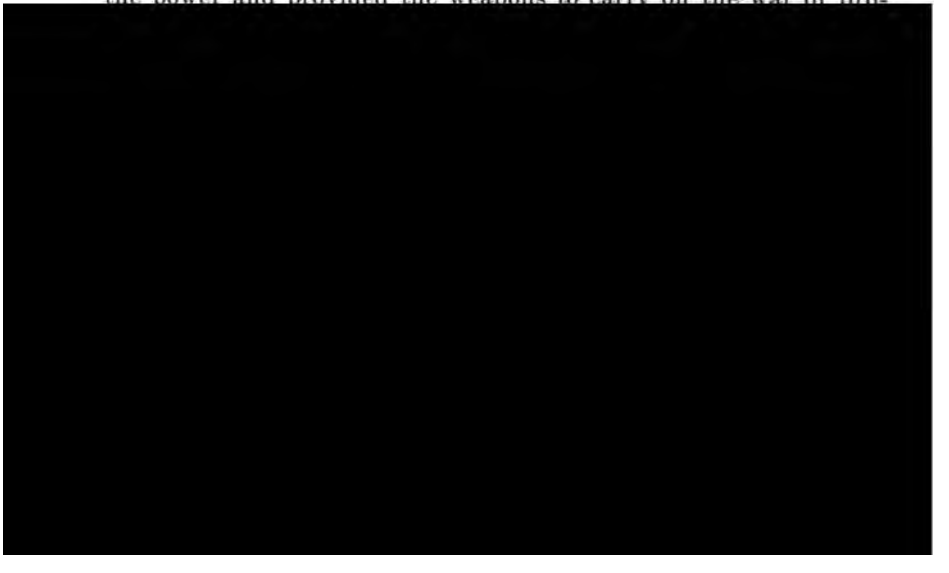
Mr. WIGHAM RICHARDSON proposed "Kindred Institutions." He said—Mr. President and gentlemen,—The toast that has been entrusted to me, namely, the health of the kindred societies, is one that it gives me very great pleasure to propose. I feel that to be a member of a learned society like this is a privilege in a great many ways. We all of us know the social side of the question. In the year that has just passed we have been at the works of Messrs. Dorman, Long & Co., where we were entertained in a

economy, and there is one thought in connection with that that has occurred to me. We have had recently in this city a visit from a very eminent political economist, Professor Shield Nicholson, Professor of Political Economy in the University of Edinburgh, and the author of a great work on the principles of political economy. We have also, most of us, read the astounding figures which Robert Giffen every now and again lays before the British public. He compiles millions upon millions in the accumulated wealth of the country. But Professor Shield Nicholson pointed out that the inherent skill, and the accumulated scientific knowledge which is the heritage of the people of England is, as part of the asset of that enormous accumulated capital, by far and away the largest, more important even than the land of the country. It is more important than the land even if you add the buildings on the land, all the industrial enterprises, harbours, and railways, and all the stock in the country. That knowledge and that skill is a more important asset in our accumulated capital than all those things put together, and that inherent knowledge and skill is very much developed and made prominent by the action of our own and kindred societies. I will not detain you longer, but I will couple the toast with the name of my friend Mr. Fletcher, who represents what may be called the parent Society, at any rate in this country, and I ask you to drink the health of the kindred societies, coupled with his name.

The toast was cordially honoured.

Mr. J. R. Fletcher said—Mr. President, Mr. Wigham Richardson, and gentlemen,—I have the honour to-night to reply to the toast you have so kindly drank—the Institution of Civil Engineers—the oldest, largest, and most influential engineering society in the world. Amongst its members must be included all the eminent engineers in this country. Amongst its Presidents are many famous names, and I am glad to say that Tyneside provided some of them—the names of Robert Stephenson, Mr. T. E. Harrison, Sir George Barclay Bruce, who are all local men, and the present President, Mr. Charles Hawksley, who follows his father after about 27 years as President of the Institution, although not a Tynesider, has been so much identified with the water works of Newcastle that I think if we cannot claim him as a Tynesider we

can at any rate claim him as an acquaintance and as a friend. The Society also embraces engineers of every class. What are called civil engineers proper are more connected with the making of large works such as railways, docks, and harbours; but mining engineers, mechanical engineers and shipbuilders, sanitary engineers, electrical engineers and all the different classes of engineers are associated with the parent society. They are all now forming Associations of their own, but still they are not leaving the Institute nor losing their interest in it, and amongst the members of your own Institution there are many who are well-known members of the Institute in London. About 12 years ago the Institute proposed to form Local Associations, which they fortunately, and rightly I think, placed under the nominal care of the students of the Institute. There are five Students' Associations, namely, in Birmingham, Manchester, Leeds, Glasgow and Newcastle, and they are all flourishing to-day. The Members of the parent Institute who are located in the district are all affiliated with these, and I think they derive more benefit from them than the students themselves. Their papers are interesting, and their visits to various works are more interesting. I would like to take this opportunity of thanking those members of your Institution who have so kindly shown the Students and their friends over their works and entertained them so hospitably. In preparing a paper on the development of railways in Northumberland and Durham there was one point which struck me very forcibly, and I think it is a point that will interest you. It was the important and foremost place that coal has taken in everything connected with engineering in this district. The working and distribution of it has not only been the initiative of invention, but it has supplied the power and provided the weapons to carry on the war of pro-



Northumberland and Durham. Then again, coal comes in in connection with the locomotive. All the early locomotives invented were for the purpose of conveying coal cheaply to the ports, and nearly all the early railways were made for the same purpose, and there is one curious fact in regard to the opening of these railways, that the first thing they did was to run a train of coals to their new drops for shipment. I think you will agree with me that coal has a great deal to do with your own Institution, for without coal you would not be able to get your iron or steel, and without the transport of coal a great many of your ships would not require to be built. In fact, if it had not been for coal the North-East Coast engineers would not have been in existence. If it was not for coal at the present time you could not exist, and you had better make hay while the sun shines, for when the coal is all done I am afraid your annual dinner will not be held on the banks of the coaly Tyne. I thank you very kindly for the way in which you have coupled my name with the toast.

Sir BENJAMIN C. BROWNE proposed the toast of "Our Visitors." He said—Mr. President and gentlemen,—I feel that whoever drew up this toast list drew it up on what we call the standard scale. First "The Institution," which has had a real value in bringing together the people whose friendly criticism has had a material effect in increasing the prosperity of the district. But we go further. It brings in other Institutions which we recognised in the last toast, and I am exceedingly glad, that we are to have a visit this year from the Institution of Mechanical Engineers. There is no doubt whatever these interchanges all tend to improve us a great deal. The great Mr. Beyer of Messrs. Beyer and Peacock's, used to say it is all very well to be able to scheme and invent, but the head trick was to find out what other people were doing, because invention only gave you your own head, but when you found out what other people were doing it gave you the advantage of the brains of all the rest. Then comes the toast of "Our Visitors," and I have to couple with this toast the name of one whose sympathy and kindly criticism has done a great deal to keep up the standard of our work, for depend upon it there is no dearer friend to manufacturers than the wise inspector—the man who sees a high standard kept up, and who won't let us produce any article which won't hold its own in the world. If we turn

out a high-class article in this district I believe it is very much owing to those who have to criticise and challenge the work we have to do. I have, therefore, to propose this toast coupled with the name of Mr. John Gravell.

The toast was very cordially received.

Mr. John Gravell responded, and said—Mr. Chairman, Sir Benjamin Browne, and gentlemen,—It is not by any means an easy thing for a man, without having the experience of being a speaker, to be able to answer to such a toast and give expression exactly to the feelings he has in him; but I thank you for the great hospitality you have always shown to all your guests. Every time we have come to these meetings we have had a good and an able man to answer this toast, and I am very sorry that I am not able to give you such a treat as you had last time. You have to-night amongst your guests a gentleman who, I think, would have done honour to this toast very much better than I can—I mean Fleet Engineer Edwards, who was Fleet Engineer of H.M.S. "Powerful" when Captain Lambton, a name well-known in this neighbourhood, landed the guns for Ladysmith. Those guns practically saved Ladysmith to us. Mr. Edwards sent a large staff and material up to Ladysmith, and his staff were able not only to look after the guns and re-mount and repair them, as necessary, but to construct distilling condensers for supplying the troops with fresh water, which materially assisted in preserving the health of the garrison during the prolonged period of the siege. We are very proud to have such a gentleman here to-night as one of the guests. I feel quite sure that Mr. Edwards would have been able to give you

Ald. W. Boyd, Mayor of Wallsend, proposed the health of "The Dinner Committee"—Mr. J. R. Fothergill (chairman), Mr. R. Thompson, Mr. H. Fownes, Mr. A. G. Schaeffer, and Mr. J. Duckitt (secretary). He said—Mr. President and gentlemen,—Although this is not regarded precisely as the toast of the evening, still I may be permitted to designate it in the old phraseology of "grace after meat." I think that the thanks of all who are present here this evening are due to Mr. Fothergill and the Dinner Committee for the very excellent dinner which they have given us to-night, and for the exertions and efforts they have made to provide us with a very agreeable evening. Perhaps the toast itself does not afford much scope for occupying your time, and indeed it is one of the characteristics of these gatherings that the toast list should be small and the speeches should be short; but there is one idea which is in my mind to-night to which this toast leads up, and perhaps I may be excused for one moment in calling your attention to it. Mr. Fothergill is a representative of this Institution, not in Newcastle, but further down the coast, and the President to-night is not a representative of Newcastle, but also hails from further down the North-East Coast. And I well remember some 16 or 17 years ago, when we were discussing the title of this Institution, it was strongly urged by my friend Mr. F. C. Marshall, of the firm of Messrs. Hawthorn, Leslie, & Co., that this was not to be a Newcastle Institution; it was not to be a Northumberland Institution; it was not even to be a Northumberland and Durham Institution, but it was to be an Institution representing the whole of the North-East Coast. And that primary principle which was established in those days has, I am glad and thankful to say, been carried out for the nearly 20 years during which this Institution has been in existence, and I believe that it represents the strength of the body which is gathered here to-night. That is to say, that although we may be local in the sense of being members of the North-East Coast we are not local in the sense that our membership is confined to any one single county or to any one particular district. We have had a very able speech to-night from what we Northumbrians would call a south countryman, down in Yorkshire somewhere, and that is an evidence that the principle that we established in those days was a sound and correct one, and that principle is no more strongly exemplified than in the person of the individual with whom I am permitted to couple this toast—

our friend Mr. Fothergill—a gentleman not only pre-eminent on these social occasions, whether it be a visit to Sheffield, or a visit to Cardiff, but Mr. Fothergill has not only the qualifications which make him most welcome and most pre-eminent in all social gatherings, but he has qualifications which render him no less an important member, and no less an acceptable member, in the scientific discussions in our meetings when technical questions are discussed. Mr. Fothergill, as Vice-President of this Institution, has rendered most valuable and serviceable assistance in many ways, and I have very much pleasure in coupling his name with this toast as representing the Dinner Committee, and of which, I perhaps may be pardoned for adding, no unworthy member is our Secretary, Mr. Duckitt.

The toast was heartily honoured.

Mr. J. R. FOTHERGILL, in reply said—Mr. President, Mr. Boyd and gentlemen,—On behalf of the Dinner Committee, I thank you most deeply for the manner in which you have received the interesting, kind, and gracious remarks that Mr. Boyd has thought fit to make. The remarks made in reference to myself are so flattering that if I were not an engineer I should blush. The Committee, as I think you may well realize, have done their best to make this evening an agreeable one to you all, and if there are faults which in a dinner of this description occasionally occur, I think that the Dinner Committee may feel themselves somewhat exonerated from blame. In reference to Mr. Boyd, whom the President had so truly said was the father of this Institution, I am sure you will all, with me, congratulate him on being nominated as the first Mayor of Wallsend. The Committee regret

Institution, Mr. Robert Thompson. We all hope he will be well enough to be with us on the next occasion. Gentlemen, on behalf of the Committee, I again deeply thank you for the way in which you have received the toast so graciously proposed by our own Past-President, Mr. Boyd.

This concluded the toast list, and the remainder of the evening was spent by the members in sociable intercourse.

# NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

EIGHTEENTH SESSION, 1901-1902.

## PROCEEDINGS.

SPECIAL MEETING OF THE INSTITUTION, HELD IN THE LECTURE HALL OF THE LITERARY AND PHILOSOPHICAL SOCIETY, NEWCASTLE-UPON-TYNE, ON FRIDAY EVENING, FEBRUARY 7TH, 1902.

HENRY WITHY, ESQ., J.P., PRESIDENT, IN THE CHAIR.

The SECRETARY read the notice convening the meeting, as follows:—"A Special Meeting of the Institution will be held in the Lecture Hall of the Literary and Philosophical Society, Westgate Road, Newcastle-upon-Tyne, on February 7th, 1902, at 7·30 p.m., when a paper by Mr. D. B. Morison, Vice-President, will be read on "Report on Memorandum submitted to the First Lord of the Admiralty on the 16th day of July, 1901, with reference to the present unsatisfactory condition of the Engineer Branch of H.M. Navy."

The PRESIDENT—As the business of this meeting is specially to hear a paper read by Mr. D. B. Morison, one of our Vice-Presidents, I will at once call upon him to read the paper.

# REPORT ON MEMORANDUM SUBMITTED TO THE FIRST LORD OF THE ADMIRALTY ON THE 16TH DAY OF JULY, 1901, WITH REFERENCE TO THE PRESENT UNSATISFACTORY CONDITION OF THE ENGINEER BRANCH OF H.M. NAVY.

By D. B. MORISON, Vice-President.

[Read before the Institution in Newcastle-upon-Tyne, on February 7th, 1902.]

Since I submitted my first paper on the British Naval Engineer to the members of this Institution, it has been very fully discussed by the Institutes of Marine Engineers in London and Cardiff. I have also read a paper on the same subject before the Institution of Engineers and Shipbuilders in Scotland, which forms Appendix A to my present contribution. (See page 125.)

It was originally intended to lay the views of the Institutions directly before the First Lord of the Admiralty, but, in July of last year, a deputation of Members of Parliament was formed by Sir Fortescue Flannery, which representatives of the Institutions were invited to join. A full report of this deputation, together with the Memorandum submitted by the Institutions, is appended to this paper. (See Appendices B and C, pages 139 and 140.)

The centre of interest, in the report of the deputation, naturally lies in the reply of the First Lord of the Admiralty, and unhappily his expressed opinions on the grave questions at issue, relating to the engineering personnel, differ so materially from those of the members of the marine engineering institutions, that the latter would appear to have no alternative but to vigorously and persistently continue to prosecute their advocacy of the drastic reforms which they know to be necessary.

The position is clear and definite. On the one side stands the Board of Admiralty, not one member of which has any engineering experience whatever, and upon which the Service is

represented exclusively by executive officers of high rank, whose traditional attitude towards the engineering personnel has ever been unsympathetic and repressive. On the other side, we find the united expert opinion of the naval engineer officers themselves, and the marine engineering institutions, which include among their members men of the highest attainments as directors and managers of shipyards and engineering works, designers, constructors, consulting engineers, and superintendents of the mercantile marine, who are undeniably competent to arrive at correct conclusions regarding the questions at issue. The attitude of the Board of Admiralty, and the inspired utterances of its official representatives, would imply a belief that the position, with regard to the engineering personnel, is perfectly safe and satisfactory, but it is the firm conviction of the naval and mercantile marine engineers that the existing position is, on the contrary, eminently unsatisfactory and dangerous.

## Undermanning.

The general question of undermanning was fully dealt with in my last paper, and the contention that the engine-room ratings are inadequate in numbers, skill, and experience, was amply confirmed by discussion in the various centres throughout the kingdom. It is, therefore, unnecessary to set forth many more examples, but it is important to note the glaring cases of H.M.S. "Hannibal" and "Repulse," belonging to the Channel Squadron (which we are led to believe is at all times prepared for war). In the "Hannibal," which has 12,000 I.H.P., there are, as per Navy List of the current quarter:—

1 Fleet Engineer.
1 Engineer of 6½ years' sea service.

The fleet engineer is in neither case supported by officers of adequate seniority and experience; the entire staff of engineer officers below the fleet engineer is composed of young men, whose experience and importance are considered to be so limited that until they attain six years' sea service they rank with sub-lieutenants and mess in the gun-room, where their juvenile surroundings cannot be conducive to their appreciation of the serious responsibilities which they are called upon to undertake. If the fleet engineer be incapacitated, the entire responsibility for the engine-room department of the first class battleship "Repulse" devolves upon six youngsters, the eldest of whom is about twenty-six, whilst of the remainder three are about twenty-one years of age. It should also be noted that it is frequently the case that "direct entry" or "temporary service" assistant engineers see a marine engine for the first time when they enter the warship to which they are appointed. There are of course several engine-room artificers, but, notwithstanding the fact that they are in many cases first class mechanics and admirable all-round men, they are not responsible officers, and responsibility, with capacity for bearing it, are the principal factors in this question. Admiral Melville, the Engineer-in-Chief of the United States Navy, in his annual report, makes the following pertinent remarks on the influence of lack of experience on naval efficiency:—

Without detracting, therefore, from the merits and capabilities of the warrant machinists, they are not altogether fitted by previous training or experience to take charge of an important department of the ship.

As a result of the inadequate supervision in the engine-rooms there has been a perceptible decrease in the efficiency of the machinery, and a progressive increase in the cost of repairs. Definite data upon this question are difficult to secure, since this retrogression is progressive in character and the full extent of the evil cannot be determined without searching investigation. The condition of the machinery of the torpedo boat flotilla shows the trend of affairs.

During the past year the disablement of torpedo boats has been of such frequent occurrence that the majority of the boats have been under repair a great part of the time. Many of these mishaps are serious in character, and the present condition of the flotilla affords an incontrovertible argument in favour of the proposition that practical engineering ability of high order is required for their successful care and operation. In my opinion the machinery of the torpedo boat craft would not be in its present deplorable condition if engineer officers of experience had been detailed for supervisory duty in connection with the boats.

It is strikingly significant that the decrease in machinery efficiency has

been most marked in the case of torpedo boats. With this type of craft it has been attempted to practically maintain the machinery in operation without the supervision of trained engineer officers. With such a system in operation it is not surprising that inefficiency should be the rule. Upon official trials the builders of such boats find it necessary to fill the engine-rooms with supervising engineers of ability and experience, who command high salaries. After such boats are turned over to the Government it cannot be expected that an insufficient and unskilled force will be capable of operating them. The depreciation of the boats will take place at a rapid rate if either an inadequate or inefficient personnel is to be entrusted with their care and maintenance.

That efficiency beneath the protective deck is no less important in naval warfare than efficiency above it cannot be doubted. The boiler plant is the heart of the vessel, and any weakness in that direction will be followed by general decline everywhere else. The difference between an efficient and inefficient force on board a warship was shown at the battle of Santiago. The crowning act of that victory was the overtaking of the "Colon" by the "Oregon." In this chase a battleship of 16 knots speed, manned by an efficient engine-room force, overtook a 20 knot armoured cruiser whose motive power was inefficiently handled, since only about one-half the boiler power was developed on board the "Colon" that could have been secured by a skilled force of mechanics and firemen directed by a trained and educated complement of engineer officers.

Although Admiral Melville severely condemns the practice of putting warrant engineer officers in full charge of machinery, the fact that he is fully alive to their importance and value is clearly shown by the following recommendation:—

That the warrant machinists be placed upon the same footing, as regards pay and rank and emoluments, as other warrant officers. In some respects the warrant machinists are discriminated against, and so long as this distinction exists they will have a grievance which must interfere with the efficiency of the engine-room force. Every avenue to promotion and increase of pay that is accorded other warrant officers should be given warrant machinists. The responsibility and character of the duty that rests upon this class of officers is as important as that devolving upon sailmakers, carpenters, boatswains, and gunners, and the opportunity for advancement should be equally as great.

"warrant" rank. One reason of this decrease in the standard of experience is that, when the warrant rank for artificers was introduced, the old rates of pay obtained; but the reduction in the rates of "charge pay" made last year, renders promotion much less attractive, and consequently the senior artificers evince no great desire to accept it.

The undermanning in stoker ratings is notorious, and in the Mediterranean Squadron recently, during full-power trials, the stoker ratings were largely augmented by deck hands. To quote actual figures, however, there was in June, 1901, a total deficiency of 700 stoker ratings in the reserves and depots, even on the Admiralty attenuated basis, whilst in December this number was largely exceeded, and in addition there was a considerable shortage of artificers. When the cruisers "Diadem" and "Niobe" were ordered to escort the "Ophir," in order to ensure their continuous steaming, about 48 stokers were added to the complements of each ship, and as their normal complement is 110, this represented an increase of 43 per cent. Extra engineer officers were also appointed. When additions are made in this manner, the official explanation frequently given is that the men are lent for training purposes, but experience has shown that, for continuous high speed steaming, these additions are absolutely necessary. The very important question therefore arises as to how they are to be found in time of war.

Viewed merely from a commercial standpoint, undermanning results in:—

(1) Increased cost of maintenance and repairs.
(2) Decreased efficiency of machinery.
(3) Increased liability to breakdown.

If the Admiralty provide complements which the engineering profession consider inadequate, even for peace requirements, surely they should be of a very high standard, and serve to leaven the necessary augmentation in time of war. It is ridiculous to suppose that engineer officers, skilled artificers, and trained stoker ratings can be created like yeomanry. In order to maintain the mechanical efficiency of a warship, an engineer officer must not only possess technical ability of a very high order, and years of engineering experience, but must also be a judicious and capable leader of men. The folly of entrusting the control of machinery

to those who have not received the necessary engineering training, is made clear by the results of actual experience in the United States Navy, as set forth in Admiral Melville's report.

It is also essential to safety, and the attainment of satisfactory results, that a large majority of the subordinate engine-room ratings be thoroughly trained and experienced men. Experience has shown that substantial differences arise in the speed of a ship, and the fuel cost per I.H.P. with trained and untrained men in the stokehold, more especially in the case of ships fitted with water-tube boilers. The practical importance of this becomes apparent when one remembers the influence exercised by speed and coal consumption upon the tactical value and radius of action of a warship.

Limitations of space, and the advisability of restricting the number of lives at stake upon any one warship, no doubt render it expedient to reduce the personnel to a minimum, but that minimum must, in each department, satisfy the requirements of efficiency, and in no department is the condition so vitally important as in the engine-room, otherwise the sole justification for the existence of the ship, *i.e.*, its fighting value, may be completely destroyed.

The prevailing opinion of marine engineers, as disclosed by the discussions at the various institutions, is that the existing scale of engine-room complements does not satisfy the requirements of efficiency, and that, in the event of a naval war, grave weaknesses in the engineer branch will be revealed to the Admiralty and the nation.

It is quite conceivable that inferior capacity, or insufficiency of numbers, in the ranks of the engineer officers, might render the mightiest warship in the Navy absolutely impotent at a critical juncture, and thereby so seriously disturb the Admiral's plan of action as to turn the balance of chances against him. There can be no possible justification for a policy that fails to restrict the possibility of such a national catastrophe to a minimum.

## Discipline.

Judging from Lord Selborne's interjected comments and reply to the deputation, he would appear to be under the impression that certain of the members who addressed him intended to imply that, under the existing conditions, there is actual in-

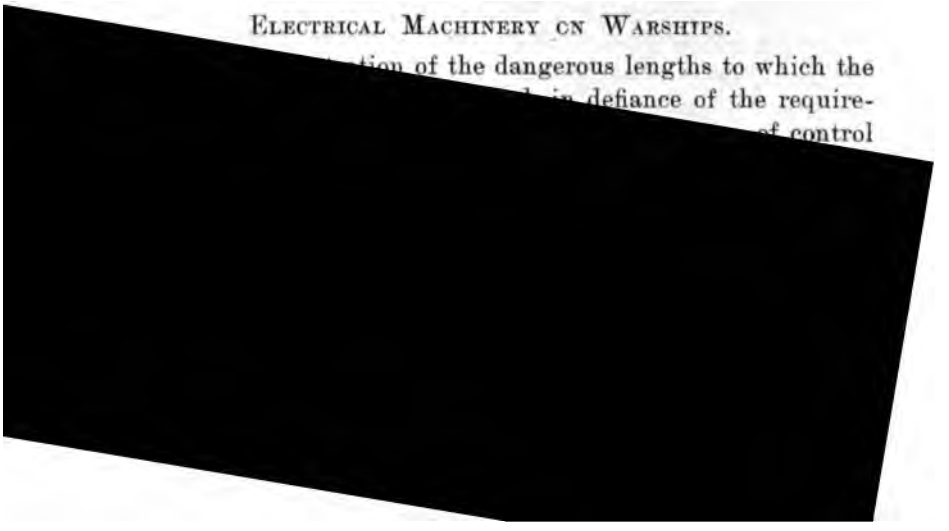
discipline, or in other words, insubordination, in the engine-room of the fleet. A perusal of the remarks of the various speakers, however, discloses no cause for any such impression. Many intermediate degrees intervene between perfect discipline and indiscipline, and the sole contention of the deputation was that the civilian rank, and accompanying restricted secondary authority, of the engineer officer, militate against the attainment of the very high standard of discipline necessary to cope successfully with the trying and difficult conditions of work in the engine-room and stokehold of a warship. In spite of Lord Selborne's denial, the justice of this contention will be at once appreciated by those possessing practical experience in the handling of men.

Why the Admiralty should, in this matter, so persistently disregard human nature and experience is almost beyond comprehension. An explanation may lie in the fact that the executive officers in command, having no practical engineering experience whatever, cannot picture an engine-room in the stress of battle. Their connection with the engine department is now limited to its inspection for cleanliness, and their experience of breakdowns is associated with slowing down, stopping, or returning to port for repairs, whilst their knowledge of panics is confined to the evidence at courts-martial after fatal explosions. The hideous possibilities of the engine-room and stokehold, during a naval engagement, are fortunately perhaps a sealed book to them and to the public, yet all can be foreseen with approximate accuracy by engineers. Panic will inevitably produce disaster, and if the stokeholds be manned with a large percentage of practically raw recruits, as they necessarily must be under existing regulations, the chances of panics occurring will undoubtedly be far from remote. It is at the critical times when explosions or derangements of machinery upset the normal routine of working, and create nervous strain, that the dangers attending the presence of imperfectly trained and disciplined men will be demonstrated. It is also, at such moments, that the safety of the ship may absolutely depend upon the presence of engineer officers, possessing not only technical ability, mature experience, and ready resource, but in addition, that class of cool courage which inspires confidence in all around them, and whose rank and authority command unquestioning obedience.

What then is the reason for the failure of the Admiralty to frankly recognize the true position? Is it that the executive officers, who rule the Navy, have failed to keep pace with the phenomenal advance of engineering science in relation to naval power, and are therefore unable to differentiate between the engine-driver of long ago and the professional expert of to-day? Or is it that these very senior and conservative officers, of the predominating branch, realise only too well the rapidly increasing value and importance of the engineer, and fear the threatened menace to their hitherto unchallenged supremacy, and to the honours and privileges at present monopolised by the branch to which long association, training, and habit have naturally directed their warmest sympathies?

Neither of these alternative explanations of the existing state of things can be a source of either credit to the senior executive officers, or satisfaction to the country, and it is to be regretted that the facts do not admit of the construction of a third alternative and more consolatory theory. Whether the underlying cause be apathy or jealousy, it is nevertheless only too apparent that the actions of the Admiralty betoken a lack of sympathy and appreciation, and afford evidence of a policy of repression towards that branch of the Service, which the natural course of evolution is ever tending to elevate and expand into a position of greater and more permeating influence upon sea power.

The essence of much of the evidence in support of these statements is contained in my former papers, but events move rapidly nowadays, and in further justification of my strictures I now propose to adduce some additional material facts bearing upon the questions at issue.



officers, who may ultimately become members of the Board of Admiralty, and it therefore enjoys much sympathetic influence in high quarters.

When electrical generating plant was first introduced in our warships, the engineer officers were made responsible for its mechanical efficiency and the torpedo lieutenant for its electrical efficiency, but it was soon recognised that this division of responsibility was unsound, and both engines and dynamos were placed under the control of the engineer branch, the torpedo lieutenant taking charge of electric circuits, lamps, searchlights, etc. On the introduction of electric motors about five years ago they were, however, placed in charge of the torpedo lieutenant, thus creating an anomalous position, whereby the engineer officers are responsible for the dynamos, whilst the torpedo lieutenant has charge of the motors. The absurdity of the situation has been enhanced by the rapid developments of electrical power on warships for auxiliary purposes. For example, in the case of electrical capstans, winches, etc., one half of each machine is under the charge of an officer of the executive branch and the remainder is controlled by an officer of the engineer branch, notwithstanding the fact that the engineer officer is in charge of a practically exact duplicate of the torpedo lieutenant's motor in another part of the ship.

There are indications that this is simply an early stage of the initiation by the "Vernon" school of a scheme for placing all deck machinery, whether electrical, hydraulic, or pneumatic, in charge of executive officers and relegating the engineer officers to the engine-room only, but the impracticability of such a scheme will be at once apparent to engineers. In the keen desire to give active expression to feelings of departmental jealousy, the fact is apparently lost sight of that it is the efficiency of the British Navy which is at stake.

It is on questions such as these that members of an engineering institution are eminently qualified to give a definite and reliable opinion, and in this case the correct solution is so obvious to engineers that it is almost impossible to conceive what prompted the Admiralty to create such a conflict of authority.

The distribution of duties which gives the torpedo lieutenant charge of electric circuits, the firing of torpedoes, laying and firing of mines, wireless telegraphy, and the like, is no doubt the

best in the interests of efficiency, and as none of them come within the scope of electrical power engineering, the training on the "Vernon" is probably sufficient for the requirements.

The position, however, is very different in the case of electric motors driving auxiliary machinery, the driven portions of which are already in charge of the engineer officer, and it is difficult to understand how any advantages can be claimed for a subdivision of authority, under which the control of the motive power of a machine is withheld from the engineer officer, who is a trained mechanical and electrical engineer, and delegated to an executive officer who is in no sense a practical engineer.

The basis of electrical power engineering is mechanical engineering; there is no royal road to become an expert except by adequate technical and handicraft training, and long practical experience. The former is necessary in order that the officer may initiate and carry out repairs with certainty and despatch, and the latter in order that he may reduce cost of upkeep, maintain maximum efficiency, and minimise accidents and breakdowns.

A lieutenant can, according to Admiralty regulations, qualify himself as a torpedo lieutenant, so far as electrical knowledge is concerned, by going through the electrical course of eight working months at Greenwich, during which seven hours weekly are devoted to this subject; a preliminary course of three months in H.M.S. "Vernon," and a further practical course of six months in H.M.S. "Vernon." During this period, few, if any, opportunities are afforded him for acquiring mechanical knowledge, and, at the conclusion of his training, he is obviously just as far from being an electrical *engineer* as he is from being a mechanical engineer.

for the efficient working of the plant, and carries out all necessary repairs in connection with the dynamos and storage service. In his fifth year, he attends a course of instruction in the electrical workshop in Devonport dockyard, and is there taught the processes of winding and insulating series and shunt coils, and also the construction of different types of dynamos, motors, switches, and all electrical fittings in use on board ship. Finally, he must, according to Admiralty instructions, qualify in electrical knowledge before receiving his commission as assistant engineer. All engineer officers, as the exigencies of the Service permit, also take a short course in the "Vernon" torpedo school, but the course is very elementary, and may justly be regarded only as a means of refreshing the memory of their early work as engineer students.

Of many available examples the following may be cited as showing the general adaptability of the engineer officer, and the practical results of his mechanical and electrical training. During the operations in China, under Admiral Seymour, two assistant engineers were employed in dismantling the steam dynamos and searchlights of H.M.S. "Centurion," and re-erecting them on shore for use on an armoured train. The whole apparatus was satisfactorily fitted up, steam being taken from the boiler of the locomotive. Subsequently the train was abandoned, and being set on fire by the Boxers, the dynamo was apparently irretrievably ruined. After the Boxers had been driven back, the burnt-up dynamo was recovered and taken to the "Centurion," where an assistant engineer re-insulated and re-wound it, and it was in successful use during the remainder of the commission.

The absence of practical mechanical ability, on the part of torpedo lieutenants and their men, is apparently admitted by the Admiralty, as during the present financial year a new rating termed "electrician" was introduced and 100 applied for. The original qualifications, as per recruiting advertisements, were as follows:—

Royal Navy Electricians.

To be able-bodied young men, with experience as fitters in electrical shops.

Examination:—

Educational.—Sixth standard; vulgar and decimal fractions; simple interest; dictation and reading.

Theoretical.—General construction of electrical apparatus; instruments; motors, etc.; simple testing.

Practical.—Re-lining and adjusting bearings; using a lathe; screw-cutting test for bolt and nut; repairs to any part of electrical apparatus, instruments, motors, etc.

There being a dearth of candidates with these qualifications, the requirements have been reduced, and this even in the short space of time that has elapsed since March, 1901.

The altered qualifications are:—

Educational.—Sixth standard; vulgar and decimal fractions will not be insisted upon; requires a good general education.

Theoretical and Practical.—Men having experience as fitters and being good workmen may be accepted even if they have very little electrical knowledge, which latter can be taught in the torpedo schools, but candidates must be good workmen at the lathe.

The position at present may be gauged by the following paragraph which appeared in the *Western Morning News* of January 2nd:—

NAVAL ELECTRICIANS.

The Admiralty still experience great difficulty in securing for the naval

over a period of seventy-two days, and is imparted by a chief torpedo instructor, who is a petty officer, but who is not himself allowed to qualify as an electrician. The workmanship test is "approved" by the senior lieutenant (T) of the torpedo school, who is neither an engineer nor a mechanic.

If the electrical training of the chief and other petty officers of the torpedo and engineer branches of the Navy is compared, it will be found that the engine-room artificers receive quite as good a practical instruction in the care and management of electrical machinery as do the armourers of the torpedo school, who are the instructors of the electricians, while the mechanical training of engine-room artificers is so far superior as to admit of no comparison.

Why then is it that, with mechanically-trained engineer officers and artificers, this new rating of "electrician" (having only purely mechanical qualification) should have been placed under the control of an executive officer having no mechanical training? It must result in further friction between the executive and engineer branches, and therefore is to be deplored by those whose chief desire is to increase the efficiency of the Service. The placing of mechanical ratings under the orders and supervision of a non-mechanical officer must result in confusion, whilst if any auxiliary machine in the engine department be ultimately driven by electric power, and the motors placed in charge of men from another branch, and under the orders of the officers of that branch, smooth working will be impossible.

The hand of the engineer is everywhere in the steam navy of to-day, and this inevitable fact must be frankly accepted if true efficiency is to be created. Neither the First Lord of the Admiralty nor the Parliamentary Secretary will ever realise the true position and its dangers until one or more engineer officers are placed on the Board of Admiralty and are there enabled to give free expression to their views as officers of military rank, and not as civilians and subordinates.

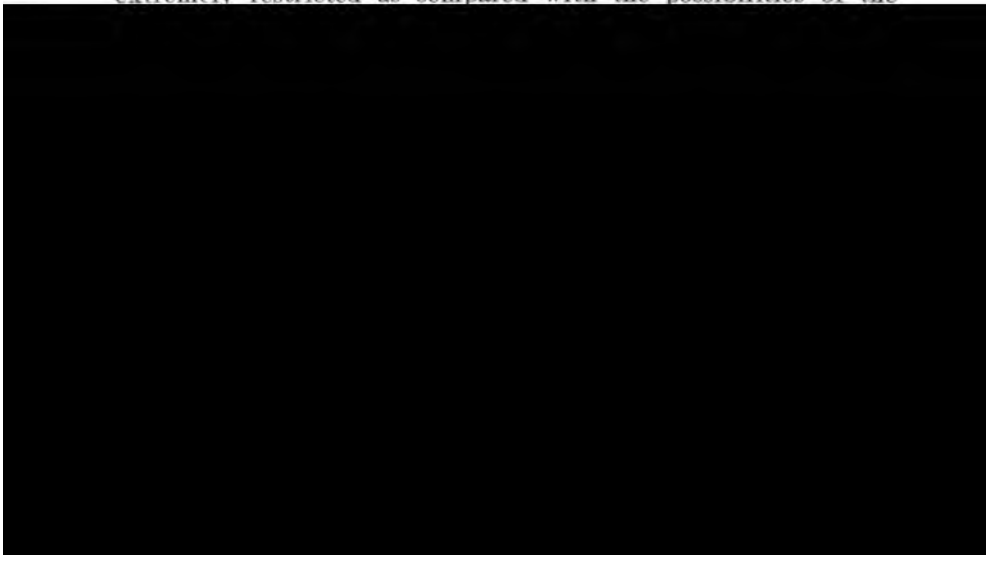
## Promotion.

At present lieutenants are promoted and obtain two-and-a-half stripes at about twenty-nine years of age, and paymasters at thirty-one, but engineers do not receive their promotion until about thirty-eight, the result being that they have to serve seven-

teen years before attaining the rank of chief engineer, and remain for nine and seven years respectively junior in rank and pay to these officers, who are certainly not their superiors either in usefulness or ability. Is it not demanding too much of human nature to expect them to feel contented and satisfied under such dispiriting conditions?

Intimately connected with this slowness of promotion to chief-engineer rank is the glaringly unjust system under which junior officers are appointed "in lieu of" chief engineers, but are refused both the nominal rank and the pay of chiefs. This has no parallel in any other branch of the Service. Amongst the many communications I have received from engineers in foreign navies was one from an officer in high position, who asked me if I would kindly confirm the truth of the statement which he had read, as he and his brother officers could not believe that such a condition could exist in the British Navy. So gross an imposition is certainly inconsistent with the traditions of this country for fairplay. There would appear to be no adequate reason why engineers should not receive their appointments as chief engineer at or about the same age as that at which the corresponding promotions are granted in other branches of the Service. Such a change would not only possess the advantages attaching to an act of reason and equity, but would make it possible to appoint chief engineers to ships of the smaller types, as advised by Admiral Melville, and so permit of artificer engineers being appointed to the junior positions on warships of the larger types, where the services of these valuable warrant officers would be utilised to the best advantage.

The ultimate limits of promotion in the engineer branch are extremely restricted as compared with the possibilities of the



| | | | |
|---|---|---|---|
| Admirals of Fleet ... ... | 5 | | |
| Admirals ... ... ... | 10 | | |
| Vice-Admirals ... ... | 21 | | |
| Rear-Admirals ... ... | 38 | Engineer-in-Chief ... ... | 1 |
| Captains ... ... ... | 204 | Chief Inspectors and Inspectors of machinery... | 20 |
| Commanders ... ... ... | 309 | Fleet engineers ... ... | 194 |
| Lieutenants and supplementary lieutenants ... | 1,205 | Chief Engineers and Engineers ... ... ... | 456 |
| Sub-lieutenants ... ... | 354 | Assistant Engineers and Temporary Service Assistants ... ... ... | 283 |
| | 2,146 | | 954 |

## H.M.S. "Britannia" and the R.N. Engineering College, Keyham.

In comparing the "Britannia," which is the training school for naval cadets, with the R.N. Engineering College at Keyham, the same inequitable state of affairs is found to exist, the "Britannia" being evidently, and quite rightly, regarded with sympathetic solicitude and interest as an important national institution, whilst Keyham College is apparently looked upon as a disagreeable necessity. The "Britannia" being in commission is superintended by a captain, who is always specially selected for this appointment, and the excellence of the training afforded by the united efforts of all the members of a large and capable staff has resulted in the attainment of a very high standard of general efficiency, which may be justly regarded as a credit to H.M. Navy, and a source of gratification to the country. The nominal head of the R.N. Engineering College is the Admiral Superintendent of the dockyard, but that officer has so much other important work to superintend that he cannot possibly devote the attention to the College which it really requires and merits, and he rarely visits it more frequently than once per term. The general control is subdivided into three departments, viz., residential, educational, and practical, in charge of a commander, headmaster, and fleet engineer respectively. There is, therefore, in reality a total absence of that single-minded, enthusiastic, and consistent guidance which can be exercised only by a single supreme authority, such as exists upon the "Britannia" to the great advantage of all concerned.

In the "Britannia" there is a residential chaplain, whose influence for good is apparent in all directions; at Keyham religious instruction is given once a fortnight by the dockyard

chaplain. In the "Britannia" every facility for work and pleasure is afforded by the sympathetic Admiralty, and £600 was lately granted for a pavilion. At Keyham a football ground is rented by the students at £20 a year, and application to the Admiral to have a portion of the recreation ground re-turfed has been refused.

The "Britannia" fully maintains the traditions of the British Navy for spotless cleanliness, but Keyham is under the Board of Works, and is painted about once in seven years. In fact if parents saw the general condition of the College in this respect they would be still more reluctant to send their sons there.

The comparative costs to the country for training naval cadets on the "Britannia" and engineer students at Keyham College are as follows:—

H.M.S. "BRITANNIA": COST TO COUNTRY PER ANNUM OF STAFF AND MAINTENANCE.

| | £ |
|---|---|
| 1 Captain and allowances ... ... ... ... ... | 1,108 |
| 1 Commander and allowances ... ... ... ... | 401 |
| 5 Lieutenants and allowances ... ... ... .. ... | 1,132 |
| 1 Senior naval instructor ... ... ... ... ... | 652 |
| 8 Junior naval instructors ... ... ... ... ... | 3,545 |
| 1 Engineer, R.N. ... ... ... ... ... ... | 201 |
| 2 French masters .. ... ... ... ... ... | 700 |
| 2 Drawing masters ... ... ... ... ... ... | 700 |
| 1 Instructor, English Literature ... ... ... ... | 300 |
| 1 Instructor, Natural Philosophy ... ... ... ... | 300 |
| Examination expenses ... ... ... ... ... ... | 180 |
| Instruments and lecture-room articles ... ... ... | 54 |
| 41 Warrant officers, N.C.O.'s and seamen instructors ... | 2,805 |
| Officers, seamen and men (wages) ... ... ... ... | 12,350 |
| Fleet surgeon and allowances ... ... ... ... | 622 |
| Nursing sisters and sick berth steward ... ... ... | 308 |
| Carpenters and other civilians (sick quarters on shore) ... | 575 |

ROYAL NAVAL ENGINEERING COLLEGE, KEYHAM: COST TO COUNTRY PER ANNUM OF STAFF AND MAINTENANCE.

| | £ |
|---|---|
| 1 Commander ... ... ... ... ... ... ... | 461 |
| 1 Fleet engineer ... ... ... ... ... ... | 567 |
| 2 Engineers ... ... ... ... ... ... ... | 402 |
| 1 Headmaster ... ... ... ... ... ... ... | 700 |
| 5 Senior, junior and temporary assistant masters ... | 1,440 |
| Draughtsmen and fees to engineers of dockyards for tuition ... ... ... ... ... ... ... | 210 |
| Models, repair and maintenance of apparatus ... ... | 193 |
| Prizes to students ... ... ... ... ... ... | 38 |
| Swimming and gymnastic instruction ... ... ... | 29 |
| Recreation fund and gymnastic gear repair ... ... | 320 |
| Mess of Officers, men, and students ... ... ... | 7,379 |
| Gas, water, electric light, and rent ... ... ... | 867 |
| Porters, stewards, writers, cooks, boy servants and labourers ... ... ... ... ... ... ... | 2,283 |
| Washing ... ... ... ... ... ... ... ... | 431 |
| Clothing allowance to servants ... ... ... ... | 62 |
| Wages of engineer students ... ... ... ... | 846 |
| Medical stores ... ... ... ... ... ... | 45 |
| Naval stores and maintenance ... ... ... ... | 1,095 |
| New works, repairs and maintenance ... ... ... | 600 |
| | £17,968 |
| Less contributions by parents and guardians ... ... ... ... £7,235 | |
| ,, Value of practical work by students as per estimate of dockyard official... 5,000 | |
| | 12,235 |
| Total for 180 students ... ... ... | £5,733 |

Net cost to country, £32 per engineer student per annum.

## REPRESSION OF ENGINEERS.

The list of inequities may be extended to allowances, pensions, honours and decorations. It is always the naval engineer who is repressed and ignored. It will be remembered that during the cruise of the "Ophir" H.R.H. the Prince of Wales, with characteristic kindly thoughtfulness, showed his appreciation of the services of the engineering personnel of the escorting cruisers "St. George" and "Juno" by sending a message congratulating them on their exceptionally good work. In contrast with this graceful act may be cited the fact that, on the return of the "Ophir," the Admiralty promoted officers of each branch on board except the engineers. Attention was drawn in the Press to this glaring omission, and it was pointedly asked why it was

that engineers came first in responsibility but last in consideration. The following paragraph then appeared:—

THE ROYAL TOUR.

The Admiralty announce; in connection with the Royal Tour, that Mr. David Alexander Stewart-Lee has been selected for appointment to the rank of senior engineer in the Royal Naval Reserve, and Mr. Sydney Montague Gardner Bryer, engineer R.N., has been noted for early promotion to the rank of chief engineer R.N. on completing the qualifying service.

Mr. Bryer is therefore apparently to be promoted to the rank of chief engineer on completing twelve years' service in the Navy. He has now completed only seven years' service, and may therefore have to wait for another five years before realising his reward for service in the "Ophir," although the officers of every other branch received theirs at once.

How bitter is the prevailing wind that blows upon the engineer branch from executive quarters may also be gauged by the following:—

On H.M.S. "Caesar" in the Mediterranean, three assistant engineers, who are commissioned officers, have no cabin accommodation whatever, and have to sling in hammocks. The undermentioned have cabins:—

(1) Wash deck boatswain.
(2) Captain's clerk.
(3) Captain's cook.
(4) Captain's steward.
(5) Captain's coxswain.
(6) Master-at-arms.
(7) Bandmaster.
(8) Ward-room messman.

Comment is superfluous.

GENERAL AVERSION TO ENTER H.M. NAVY AS ENGINEER OFFICERS.

serious cause for astonishment and grave concern is afforded by the meagre lists of candidates, and the attenuated numbers of actual entries into the appointments offered year by year by the Admiralty in the engineering branch of the Service. This too, in spite of the fact that during the past ten years, the rapid growth in the importance of naval engineering has brought the profession prominently before the public notice. There is good reason to believe, however, that the wide publicity given to the subject by its discussion at meetings of the engineering institutions is tending to accelerate the approach of the acute stage of inadequacy of supply which will render decisive action on the part of the Admiralty imperative.

The extent to which public interest in the situation has been aroused is indicated by the unprecedented demand for copies of the *Transactions* of this Institution, whilst my personal correspondence from all parts of the Kingdom, and even from the Colonies, is becoming greater than I can deal with. The tenour of my correspondents' communications clearly shows that there is a distinct disinclination on the part of parents to embark their sons on so unpromising a career as that of an engineer officer in H.M. Navy, under existing regulations. We are thus face to face with the deplorable fact that, as the knowledge of naval engineering as a profession is becoming more widely spread, the desire to enter it is steadily diminishing. A startling illustration of this truth is afforded by Diagram 1 (Plate XI.), which shows an alarming decrease in the number of candidates for each vacancy at the Royal Naval Engineering College at Keyham since 1897. In the year 1901 forty-five vacancies were announced, yet so few of the candidates obtained even the qualifying marks that the Admiralty were unable to meet the requirements. It is perfectly evident that the Navy must suffer from this spiritless competition, as the amount of material available is insufficient for the effective application of the selective process.

That the authorities are naturally alarmed is evident from the fact that they recently issued a circular to the headmasters of schools urging them to send up boys for examination. For no other branch of the Service has it been found necessary to have recourse to such measures. The competition for entry into the "Britannia" and Woolwich is immense, but for the Engineering College at Keyham it is practically non-existent.

It will be seen from the following extract from the report of the recent annual meeting of the Incorporated Association of Headmasters, that they have declined to respond to the Admiralty's appeal, whilst the existing position of engineer officers remains so very unsatisfactory.

Mr. Easterbrook, in moving the following resolution, "That this Association desires to draw attention to the unsatisfactory conditions of service of engineer officers in His Majesty's Navy, and to urge upon the Admiralty, that until the Service is made more attractive, as to both the status and the pay of these officers, there will be a dearth of many desirable candidates, and a great loss of efficiency to the nation," said: The resolution I have to propose may at first strike some of you as not being quite within our province; but I hope I shall convert you. I believe that the majority of masters who have sent in candidates for the Naval Engineering College, I fancy all of them, are aware that there is a great deal of dissatisfaction, which has existed for a long time among engineer officers. It is a large question, and I cannot propose to go into it very fully, but I will put the main points before you. Engineer officers for the Navy, after passing an entrance examination, go through a five years' course of training at the R.N.E. College, Keyham. This training is obtained between the ages of sixteen and twenty-one, the expense to the parents of the student is considerable, and the student himself must pass his periodical examinations well, or he endangers his chances of remaining in the service. Well! he goes through at least five years of specific study before he can become an "assistant" engineer, and then he may go direct to sea. He must study three years more in order to become a "professional" engineer. Two years after the end of the eight years, he has a further examination before he gains the title of "engineer," and at a still later period he has again to face an examination if he aspires to be promoted to "chief" engineer. When he goes to sea he finds that according to the King's Regulations he is in a position of enormous responsibility, for to him is entrusted what Mr. Goschen calls the "fiendish complications" of the machinery of our ships of war. He must keep all this machinery in perfect order; for example, the engines, torpedoes, and so on—we all know what a ship of war is, as most of us have been over one at some time of our lives—and he must see that the men perform their duties with promptitude and to the best of their abilities. But

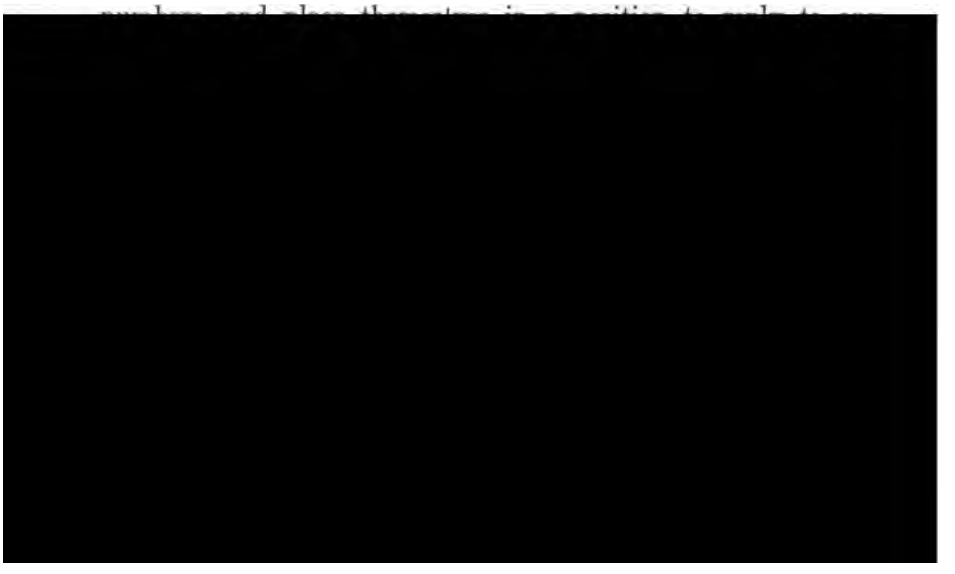
with the executive branch, unsatisfactory. Also the number of officers in the highest ranks of these branches is disproportionate, *e.g.*, out of 1800 executive commissioned officers there are 200 of captain's rank; out of 900 engineer officers only 20 rank with captains. Then another point is just as extraordinary to the ordinary mind. The engineering branch has not a single representative on the Admiralty Board. Considering what the Admiralty Board has to decide that is a sufficiently startling statement. And, lastly, their pay is not satisfactory. Well, the natural result of the dissatisfaction which this state of things entails is that while the total horse-power of His Majesty's Navy has steadily increased of late years, the number of candidates for this service has just as steadily decreased. The matter has been brought before the Admiralty by influential deputations, but owing to prejudice and service jealousies, and also red tape, nothing material has been done. Now the American Navy—and it is interesting for us to note this—has gone through just the same experience, but after enquiry by a Board presided over by the present President of the United States a complete amalgamation of the executive and engineer officers was made, with one uniform scale of pay and rank, and with uniform powers and privileges. Then I may recall to your minds that the early history of the Royal Engineers in the Army has been much the same. We all remember the old days when the engineer officer was considered something much below the ordinary line or cavalry officer. That body was finally organised and made into a military body, and the outcome has been the production of such officers as Lord Napier of Magdala, General Gordon, and finally Lord Kitchener. When the guns had to be taken up to Ladysmith—the guns that saved Ladysmith—the engineer officer, the non-combatant engineer officer, was found working beside the executive officer, he had to help devise means for getting the guns up there, and he was not a combatant engineer for all that. The question is whether every naval officer should not be an engineering officer, and an Admiral said as much in a letter to the *Times* a short time ago. I will just state shortly what naval engineer officers ask for. It is that they should become combatant officers, a corps of Royal Naval Engineers being formed, officers to be executive in their own department, under the orders, of course, of the captain or officer in command of the ship for the time being, with powers similar to those of all executive officers. The engine-rooms of our ships are already under-officered and the number of ships is increasing out of all proportion to the number of engineer officers. I believe myself that this is a matter of vital importance to the future of the Navy and to the safety of the Empire, and I ask you, by voting for this resolution to-day, to show that you consider it so. Unless the service is made more attractive we cannot be expected, as Headmasters, to send our best and most promising pupils to go through a long course of training for this service, and if the Admiralty have to be content with inferior men and to resort to temporary expedients it will be at the expense of the efficiency of the Navy and the safety of the Empire. He begged to propose the resolution.

The Rev. Dr. Fry, of Berkhamsted, in seconding the resolution, said it was little less than snobbery that a naval engineer officer should not be encouraged and rank higher than he did. It was part of the same silly policy that put distinguished Colonial leaders in the early part of the Transvaal war lower than some young person fresh from Sandhurst. They should continue to press for a change in the interest not only of their scholars, but of the country.

Mr. A. W. Reith, of Halifax, supported the resolution, and it was carried.

In their efforts to cope with the difficulty experienced in obtaining a sufficient number of engineer officers for the fleet, the Admiralty introduced a scheme by which the numbers could be augmented by so-called "direct entry," and this proving ineffectual, they further reduced their standard of qualification by instituting entry for "temporary service." Without going into the details of these two methods, it may be explained that the qualification for "direct entry" consists in obtaining a minimum of thirty per cent. of marks for the obligatory subjects included in the final examination at Keyham, while for "temporary service" no educational certificate whatever has to be obtained. But even with these easy means of access, it is to be noted that each year a smaller number of candidates present themselves for acceptance, and if any further proof be required of the straits to which the Admiralty are now put, it is to be found in the printed statement of the results of the examination held in May last of candidates for "direct entry." Only fourteen candidates presented themselves. Ten of these were accepted and the remaining four were informed that they might enter for "temporary service. Of these four, one wrote to the Admiralty to the effect that unless he received a permanent appointment he would reconsider his decision to enter the Service at all. His request was granted. One of the remaining three, after some experience, resigned his position as "temporary service" engineer officer, and actually elected in preference to become an artificer.

This last case is of special interest and shows the extent to which those in power have dared to lower the standard in the engineering branch in their anxiety to obtain the necessary



days. No eligible candidates were forthcoming, and in consequence no examination was held.

Diagram 6 (Plate XIV.) shows the number of approved candidates for "temporary service" assistant engineers from 1895 to date, from which it would appear that the decline has been somewhat proportional to the extended knowledge of the unpleasant facts.

Finally, so unattractive is the life of the naval engineer that it is not surprising that a number of engineer students leave Keyham College to enter upon other and more promising careers. During the last nine years no fewer than thirty-two engineer students have resigned or been withdrawn by their parents or guardians, and there is a distinct falling off in the performance of those who remain. This has caused a reduction to be made in the standard of attainment required to qualify as an assistant engineer for the further course at Greenwich. The percentage of marks which, according to the regulations, must be obtained has been reduced from 60 to 50 per cent., but at the present time only six of the eleven assistant engineers who left Keyham at the end of May last, and who are now at Greenwich, obtained the marks necessary according to this reduced standard; four of the remainder obtained the marks necessary for a second class certificate (which does not carry with it the qualification for the Greenwich course), and one obtained only sufficient marks for a third class certificate.

It is useless to mince words at this juncture. The position is now so serious that it must be attacked boldly in unmistakable language. It can serve no useful purpose to imitate the disingenuous style, or to adopt the obscure and hollow language of official utterances in deference to official susceptibilities and habit. It is, therefore, refreshing to find such an eminent authority as Colonel Denny, M.P., Member of the Council of the Institution of Engineers and Shipbuilders of Scotland, expressing his opinions so definitely at the interview with Lord Selborne. Colonel Denny said:--

> I do not propose to enter into any arguments why you do not get the men; it is sufficient that your lordship does not get the men, and will not get them upon the present conditions. Whether the Admiralty desire to get them is another matter, but the conditions offered by the Navy to engineers are not such as to tempt them to come to you in preference to the Mercantile Marine. Their rank is not recognised, they are looked upon tacitly as an inferior class

of men, and their status is ignored. The result of all that is, when you come to the country for men you do not get them. I know that recruiting has been established in large towns, and on our own account, in our own works, our men have been strongly urged to join His Majesty's Navy, but the result of the attempt has been total failure. I think any person with any knowledge of the Admiralty conditions will admit that the supply of men for the engine-room is totally inadequate.

Colonel Denny's views are amply confirmed by Diagrams 3 and 4 (Plate XII.), which show the yearly increase in I.H.P. for the last twenty years, and also the corresponding increase in the number of engineer officers. In 1882 the total indicated horse-power in the British Navy was about half a million, and in 1901 it had increased to three and a quarter millions. In 1882 the number of engineer officers was 702, and on June 30th, 1901, the number was 954 engineer officers and 65 warrant officers (artificer engineers), making a total of 1,019.

Diagram 4 (Plate XII.) shows that the I.H.P. per engineer officer of all ranks was, in 1882, 910, and in 1901 no less than 3,219.

Even to the non-technical public these figures are impressive, but their real import can only be appreciated by professional engineers, who realise that the call for a continual exercise of technical ability and mechanical skill, on the part of the engineer officers and artificers, is vastly greater now than it was twenty years ago.

Diagram 5 (Plate XIII.) will appeal to the commercial instincts of the British public, as it shows that whilst the expenditure on new ships was £800,000 in 1872, it had risen to £9,000,000 in 1901, or eleven times greater, and that although the technical demands of the machinery under the control of the engineer is an ever-increasing quantity, the commercial value

retired from active service, so that he may escape the professional opprobrium which apparently attaches to those who advocate any advancement in the status of the engineer officers in H.M. Navy.

## The Memorandum.

The principal measures of reform recommended by the marine engineering institutions for the amelioration of the present unsatisfactory condition of the engineer branch of H.M. Navy are succinctly stated in the memorandum which forms an appendix to this paper. (See p. 139.)

The fundamental requirement is that the engineering branch be formed into an independent military corps, the Royal Naval Engineers, which shall be treated and regarded as a combatant branch of the Service, having military functions and responsibilities within itself. Such a reform, by giving to the engineering profession in the Navy the honourable position and authority due to a factor which underlies all material advance, and which will undoubtedly exercise a determining influence upon the naval warfare of the future, would render the engineering branch far more attractive to the class of men best suited to become engineer officers. This, in conjunction with its other far-reaching, direct and indirect effects, would result in a great and invaluable increase in the fighting efficiency of H.M. Navy.

Whatever the ultimate developments may be, the members of the Institutions do not at present recommend an amalgamation between the engineer and executive branches, being of opinion that, by reason of the wide scope and rapid advance of engineering science, the mechanical efficiency of a warship can be best maintained by engineer officers, whose whole lives are devoted to their profession, and who, especially when occupying the higher and more responsible ranks, can bring to bear upon the many vital mechanical problems that must arise in naval warfare a mature experience and sound judgment which will inspire in their men that implicit confidence which is so essential in times of difficulty and danger, and can be promoted only by a recognition of superior engineering capacity.

In conclusion, I would venture to touch briefly upon the responsible, and almost fiduciary, position in which the marine engineering institutions stand in relation to the lay public, in respect of that greatest of all marine engineering organisations

in the Empire—the Navy. An aggregation of independent selfish individuals cannot constitute a nation. Mutuality is essential to the existence of a community, and surely the special knowledge and influence of an individual or a class involve somewhat proportional corresponding duties and responsibilities towards the community of which they form a part. Naval engineering being a technical and complex subject, the general lay public cannot of their own knowledge and unaided perception gauge the present position of affairs in the engine-rooms of H.M. ships, and appreciate the dangers arising therefrom. The vast majority of the marine engineers of this Country are now fully acquainted with all the material facts relating to the engineer personnel of the Royal Navy, and, in virtue of their special training and experience, they are eminently qualified to form reasonable and correct opinions upon them. Surely it is a patriotic duty, unmistakably devolving upon them, to sound a note of warning, and to do all that may lie in their power to bring about a better and safer state of things. Never in the history of engineering institutions has so unique an opportunity been afforded to a civilian class to perform a service of such value to the nation at large, as that which now lies at the hands of the marine engineering profession.

I again appeal to the members of that profession not to let the call of duty die away without response, in the immediately comfortable belief that it is nought but an alarmist note, lest when the nation finds itself in the throes of a great naval struggle, with the ultimate vital issue hanging precariously upon the realisable fighting powers of the fleet, they suffer all the remorse and bitter humiliation of a guilty consciousness that the

"Gunnery lieutenants to have charge of and be responsible for the care and maintenance of all gun mountings, as well as for the hydraulic fittings in connection with the guns and hydraulically worked machines (outside the pumping engines) at present used for serving them.

"Torpedo lieutenants to have charge of and be responsible for the care and maintenance of all dynamos, electric motors, electric lighting, Whitehead torpedoes and discharges.

"Engineer officers to be in charge of all steam-driven machinery, and for the supply of water, electricity, or air, at the required pressure, and where dynamos are coupled to steam engines they are to be responsible for running them and supplying electricity at the proper voltage at the machine terminals."

The Lords Commissioners of the Admiralty also direct the captains of the "Vernon" and the "Excellent," and the chief inspector of machinery at Portsmouth, to consider and report upon the methods best calculated to facilitate the adoption of the change, including the revision of the courses of instruction for officers of both the military and engineering branches, and urge that the re-arrangement, whereby the engineer officers will be freed for work from which they can ill be spared, may take place as soon as possible.

A staff of hydraulic and electric artificers is to be introduced, who will work directly under the orders of the gunnery lieutenant and torpedo lieutenant respectively.

This is the scheme foreshadowed in my paper as a probable counter move, on the part of the executive branch, to the persistent demand from other quarters for engineering reforms of a very different character.

So long as the fighting organisation of our warships is divided into two great military and engineering departments, controlled by distinct classes of specially and differently trained officers, it is but a truism to state that the destructive powers of the armaments can be best developed and applied by those officers who are by profession naval tacticians, gunners, and torpedoists, and are assisted by a staff specially trained and disciplined in the use of those armaments.

Following the same line of reasoning, is it not equally a truism that the efficiency and workability of the highly mechanical modern armaments can be best maintained by officers who are

engineers by profession, and are assisted by a staff of trained mechanics?

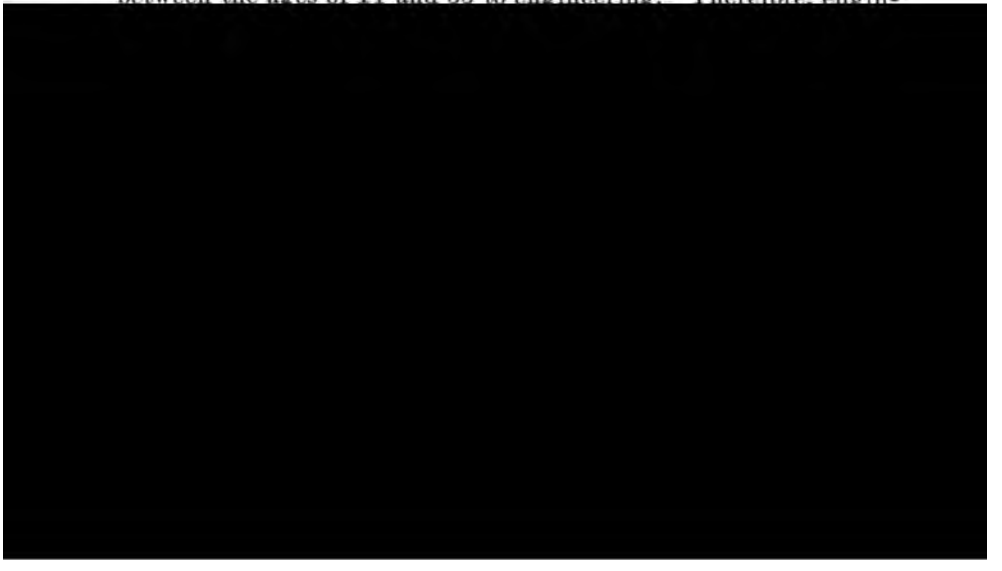
There is, of course, no reason whatever why officers of what is at present known as the executive branch should not have sole charge of the maintenance, repair, and manipulation of armaments, or, for that matter, of the whole of the ship's machinery, *provided that they first become thoroughly trained and experienced engineers.* It is not a matter of conventional distinctions of class or title, it is purely and simply a question of competency to perform the duties with maximum efficiency.

There is no royal road to engineering proficiency, and engineers do not require to be reminded of the fact that, if the duties devolving upon the executive branch under the new scheme are to be undertaken by officers competent to fulfil them, very many years must elapse before the scheme can possibly become effective.

Such is the position, assuming that the scheme has been devised with a single eye to the creation of increased efficiency, and that an honest and thorough attempt is to be made to realise its face value. That, however, is the crux of the question, and the wording and tone of the Admiralty order, promulgating the new scheme, bear strong indications of an expectancy of early results which cannot but be premature and abortive.

If officers of the executive branch are to undertake engineering duties, they must be trained as engineers from their early youth upwards.

Another point, which it is necessary to note, is that gunnery and torpedo lieutenants serve in those capacities for only a limited period, whereas engineer officers devote their whole lives between the ages of 14 and 55 to engineering. Therefore, engin-



training of whom no provision would appear to have been included in the new scheme.

Engineering is the foundation of modern naval power; navigation, tactics, gunnery and torpedoing constitute the superstructure, and any attempt to invert this natural order must end in failure. Therein lies the radical weakness of the new scheme.

It is a significant and noteworthy feature of the Admiralty order that the radical changes which it institutes have first been definitely decided, and that the expert advisers of the Board have been subsequently called upon to bear the onus of devising means by which the changes may be most advantageously carried into effect. Had this order of procedure been reversed, it would at least have prevented any suspicion that the order had been issued in nervous haste, with a desire to forestall discussion of questions of naval engineering reform by the House of Commons and the Engineering Institutions. The interest of a considerable portion of the community has, however, now become aroused, and will quickly develop into strong public feeling, in the face of any attempt to dominate the question of general naval efficiency by such secondary considerations as the maintenance of executive privileges.

If the Admiralty propose to make some of the executive officers engineers, then it is obvious that they cannot consistently refuse to make engineers executive officers with control in their own department.

One is tempted to ask why the Admiralty did not go a step further, and make the navigating lieutenant responsible for the steering gear and windlass, but perhaps this caution sprang from fear of a *reductio ad absurdum.*

The Admiralty, in its desire to disclose some justifying motive for the institution of the new order of things, advances the proposition that the new distribution of duties will free the engineer officers "for work from which they can ill be spared." It is difficult to reconcile this with the reply made by the First Lord of the Admiralty to the Deputation on the question of the alleged shortage of engineers.

The formation of three independent corps of artificers, under officers of different branches, would also appear to completely destroy that elasticity of utility which is essential to the economical and effective application of the services of the mechanical

staff. If an industrial concern were organised on similar lines, the resulting extravagance of labour would result in certain bankruptcy.

Another very serious aspect of the case, and one apparently quite overlooked by the promoters of this scheme, is that the duties of electric artificers and hydraulic artificers will be far more pleasant, and in every way preferable, to those of engineer artificers, so that still greater trouble will be experienced in obtaining men for the engine-room ratings, even if greater pay be offered.

It may well be that the scheme is the initiation of a system whereby executive officers will take the place of engineer officers, the artificers being retained, as it is impossible to set a limit to the ambitious creations of non-engineering minds on engineering matters. Machinery, however, will only respond satisfactorily to skilful and experienced care and manipulation, and the good intentions and aspirations of those attendant upon it will not serve to ward off the results of incompetence. The disastrous consequences of entrusting warship machinery to the care of officers and men, of inadequate skill and experience, are set forth with great emphasis in Admiral Melville's report, and as his conclusions are definite and based on the actual war experience of the United States Navy, it would be flying in the face of facts to ignore them.

Those who have closely followed the workings of the Admiralty in relation to Parliament and the public, can readily foretell the probable trend of its future action. Such action will possibly take the form of some minor and unimportant concessions leaving the main question undealt with. This, however, will not obscure the judgment of the engineering profession and we in

# APPENDIX A.

## THE ENGINEERING CRISIS IN THE NAVY.

By D. B. MORISON, M.I.N.A., M.I.M.E.,
Vice-President, North-East Coast Institution of Engineers and Shipbuilders.

(Read before the Institution of Engineers and Shipbuilders in Scotland on 18th December, 1901.)

The vulnerability of our wide-spread imperial position, our dependence upon sea-borne food stuffs, and the close connection between our maritime commerce and industrial welfare, should render all questions relating to the true and realisable value of our naval power of supreme interest and importance to every thinking citizen of the British Empire.

The first essential of the thinking process, however, is the possession of food for thought, and the exigencies of modern life demand that this shall be supplied to the public in a concentrated and easily assimilated form, prepared, preferably, by recognised authorities, in whom the public repose sufficient confidence to enable them to form a conscientious opinion without subjecting the facts as submitted to much independent and troublesome analysis. The vast majority of people being almost entirely absorbed in the necessary and exacting task of earning a living, and having their attention closely concentrated within their own particular sphere of life, it is scarcely to be expected that any considerable proportion of them will make a study of such special questions as national defence or the engineering requirements of modern navies. To the illiterate, such matters are necessarily a sealed book, whilst the bulk of the educated classes regard them as too complex and mysterious for their comprehension; or, what is even more regrettable, consider them to be of very abstract importance to the individual, and are therefore quite content to exercise that blind faith which is so conducive to ease of mind, and to place implicit confidence in those ministers of state and public officers who are specially appointed by the nation to safeguard its interests. Herein lies the danger that existing sources of weakness may be covered up and perpetuated, until a great national crisis, calling for the full and prompt exercise of the nation's powers, reveals in all its nakedness the appalling fact that the legitimate expectations of the country cannot be realised and that the heavy premiums for national insurance have been paid into public departments which are in the moments of danger incapable of fulfilling their vast responsibilities. It would surely be foolishly optimistic to expect drastic reforms to be initiated by those public servants, upon whom they would necessarily inflict personal loss, inconvenience, and endless worry, and of whom but very few could expect to reap any reward or distinction.

In view of these facts it is the duty of the engineers of this country to closely study the engineering crisis in the evolution of the modern navy, and

to assist in the education of public opinion by disseminating authoritative statements of this collective opinions, and their recommendations for the creation of greater efficiency in the engine-rooms of the fleet.

It was due to a sense of this duty that the author prepared his first paper on "The British Naval Engineer," which was read last March before the North-East Coast Institution of Engineers and Shipbuilders at Newcastle and, at the conclusion of the discussion, that Institution fully endorsed the views on this point which had been expressed, by resolving that in view of the national importance of the subject, the kindred institutions throughout the Kingdom should be invited to take part in its further discussion.

The President and Council of the Institution of Engineers and Shipbuilders in Scotland, with characteristic insight and energy at once appreciated the national importance of the issues involved and cordially responded to the invitation, by giving immediate expression of their desire to assist in the patriotic duty of promoting the much-needed reforms in the engineering department of H.M. Navy.

It is the primary object of this supplementary paper to deal with some of the broader aspects of the question, but it is also desired to bring to your notice certain developments which have taken place since the reading of the first paper, so that you may discuss the subject with a full knowledge of the up-to-date facts so far as it lies in my power to supply them within the limits of the time available.

In an addendum to the paper on "The British Naval Engineer" an abstract was quoted from the statement of the First Lord of the Admiralty, explanatory of the Navy Estimates for 1900-1901, which explained the nature of certain minor concessions that had been made in respect of the promotion, status, and pay of engineer officers and were described by the First Lord as the result of the deliberations of an Admiralty Committee. It may be mentioned in passing that this committee consisted of Rear-Admiral Douglas, Capt. Prince Louis of Battenberg, and Mr. M'Cartney, M.P., the engineering branch, it will be noted, being entirely unrepresented. It is interesting to contrast the constitution of this committee with the *personnel* board appointed in 1897 by the United States Government, to report upon the causes of the then existing dissatisfaction of the naval engineers, and the friction between the executive and engineering branches, and to formulate a scheme for reform which would establish conditions more conducive to the efficiency of the U.S. Navy. This board consisted of seven executive and four engineer officers, and was presided over by Mr. Theodore Roosevelt, assistant secretary of the navy department.

pay to engineers at the top of the list is in the aggregate very serious now that they have to wait so long for promotion to chief engineer rank. The rate of charge pay has been reduced from a maximum of 9s. to a maximum of 5s. per day, and the decrease in the rates actually paid amounts to 44 per cent. in the case of large ships, and 66 per cent. for second-class cruisers. This too, in spite of the fact that although the maximum rate of daily pay for fleet engineers has been raised from 26s. to 30s., it is still less than that obtainable in the other civil branches of the service, in which the daily pay rises to a maximum of 33s.

The question of engineer officers' pay, however, is of subsidiary importance, as viewed from a national standpoint, and the unreality of these alleged concessions has only been referred to for the purpose of illustrating the discreditable spirit in which the interests of the engineering branch of the Royal Navy are dealt with by the Admiralty.

Although the rates of pay must necessarily have a direct and important bearing upon the quality of the engine-room staffs obtainable, it is quite certain that no radical improvements will be effected in that direction until the engineering branch is adequately represented upon the Board of Admiralty, and with a view to securing this drastic reform it is advisable that we should use arguments which are less subject to public suspicion than those based upon considerations of engineers officers' remuneration.

Unhappily for the nation, there is no lack of material for a strong case against those responsible for the perpetuation of the existing inefficient organization.

Recent experience with our most modern ships, fitted with Belleville boilers, has amply confirmed the statements made in my paper with reference to the inadequacy of the engine-room complements in numbers, skill and experience. The Admiralty do not appear to have grasped the obvious fact that the recent radical changes in *matériel* in respect of boilers, increased steam-pressures, and increased complications of the machinery and armaments of our warships as a whole, demanded simultaneous changes in the numbers, organisation and training of the engineering *personnel*, and whatever may be the inherent defects of the particular type of water-tube boilers which the Admiralty has adopted on so wholesale a scale, there is good reason to believe that a defective *personnel* has been a contributory cause of the very serious troubles which have been experienced.

The following significant remarks were made by Admiral Sir Nathaniel Bowden-Smith, K.C.B. (Commander-in-Chief at the Nore), in the course of a recent discussion on "The Training of Seamen," at the Royal United Service Institution, and contain a highly authoritative, though no doubt unintentional, admission of the existing dangerous state of things in the engine-rooms of the Navy:—

> "The lecturer treats of the question of training seamen as though they were the only people to be considered in a modern fighting ship, whereas the engine-room staff are amongst the most important ratings, and I do not see how you can consider the training of seamen apart from the rest of the ship's company. As I understand Sir Gerard Noel, and the school which he represents, he would have two or more training squadrons of masted ships fitted with screws and engines, and therefore requiring a certain number of stokers. On an emergency arising, these are all to be turned over suddenly to modern ships, so that the engine-room ratings would find themselves

under new conditions, having to contend with water-tube boilers and steam at 300 lbs. pressure with all its results. The consequence will be a breakdown in the engine-room, and then what will be the use of the gunners, even though they should shoot better than other men trained in modern ships, which I very much doubt? In advocating such a system, *I fancy my friend Sir Gerard Noel can hardly realise the somewhat bitter experience we are undergoing at present with the boilers and machinery of some of our ships.*"

Ships fitted with water-tube boilers require from 30 to 40 per cent. more stokers than ships of the same power fitted with tank boilers, without making any allowance for men sick or in cells, etc., and not only are these greatly increased numbers necessary, but it is absolutely essential, if the boiler-room duties are to be efficiently and safely performed, that the stokers shall be thoroughly expert. So tardy has been official recognition of these facts, that the numbers, even of untrained stokers, now available fall far short of the real requirements of the ships in commission, and it is only within the past few months that any steps have been taken to give the second-class stokers even a superficial training in boiler-room duties, before drafting them to sea-going ships. Money, and still more valuable time, have, however, been prodigally expended upon instructing stoker recruits in military drill and the use of arms. To the ordinary mind it would appear that the ability of a stoker to hit a hay stack at 50 yards is of insignificant importance to the nation as compared with his ability to efficiently perform his proper duties in the boiler-rooms of the fleet. No doubt the military instruction imparted is useful as a disciplinary training, but the impossibility—if such there be—of combining discipline with the performance of their proper duties is not quite apparent.

An excellent and very carefully prepared article, entitled "We always are ready," by Rollo Appleyard, which appeared in the September number of *The Fortnightly Review*, contains some convincing figures demonstrating the dangerous extent to which the engineering branch of the Navy is under-officered and undermanned.

It is stated by the author that, according to the Admiralty's own admissions, 1,255 engineer officers, 3,277 engine-room artificers, and 29,387 stokers, of various ranks and ratings, are required to enable the ships of H.M. fleet to put to sea, whereas the actual numbers at that time available were: 961 engineer officers, 3,024 engine-room artificers, and 21,472 stokers; the deficits being thus, 294 engineer officers, 253 engine-room artificers, and 7,915 stokers.

working mechanics of the fleet. Every development in machinery demands increased practical skill on their part, and it is necessary that they should not only be good handicraftsmen and competent sectional watchkeepers, but that they should also have a good general knowledge of the details of the machinery and armaments. Every advantage in pay, and comfort on board, should be offered to induce the right class of men to join. The Admiralty have recently appointed well-known engineers in different parts of the country to recruit artificers, and although the understanding is that they are not to be too exacting as to qualifications, the numbers obtained are very disappointing and quite inadequate to meet the requirements of the Service. My personal experience, in the works with which I am associated (and to which reference was made by Sir Thomas Richardson in the course of his contribution to the discussion on my former paper), has been that, although I took considerable trouble to induce intelligent young journeymen to volunteer as naval artificers, they one and all refused. To my astonishment I ascertained, however, that a blacksmith's striker had offered his services and had been accepted. This is only one typical instance of the lowering of the standard, which is not only dangerous by reason of the incompetency of the men enlisted, but tends to create discontent amongst the skilled and experienced members of the engine-room staffs, upon whom an unfair proportion of the work to be done is necessarily thrown.

The Admiralty appears to have lost all sense of proportion in its dealings with the engineering *personnel* of the Navy, towards which its attitude is one of toleration merely on account of its necessity. No really honest effort has yet been made to grapple with the difficulties, and all concessions which have been granted have been half-hearted, grudgingly bestowed, and for the most part clumsily devised, as, for example, the new scheme of engineers' pay and charge pay already referred to. In order to cope with the shortage of engineer officers, recourse is about to be made to an unfortunate expedient which has always caused annoyance and irritation, and has, therefore, tended to induce inefficiency. I refer to the introduction into the Navy of temporary service engineers, for which an examination is to be held this month. Such a system of entry, through outside channels, destroys the uniformity of training and the homogeneity of the whole body of naval engineers, and is extremely unfair to those officers in their relationship to other branches of the Navy. It is also unfair to the engine-room artificers, the senior and more competent of whom should be given more rapid promotion to the warrant rank of artificer engineer, and thus fill some of the places which these new men are to be brought in to take over their heads.

The serious dangers attending the present attenuated and insufficiently experienced engine-room complements which are provided on our modern war ships are effectively illustrated by the recent disastrous voyage of H.M.S. "Hermes." This ship is a second-class cruiser, fitted with twin screws and engines having an aggregate of 10,000 I.H.P., supplied with steam by 18 Belleville boilers carrying a steam pressure of 300 lbs. The auxiliary machinery consists of the undermentioned 47 engines:—

4 Circulating engines.
2 Sets of distilling plant.
2 Sets of engines and dynamos.
1 Double-cylinder steering engine.
2 Sets of air compressors.
1 Refrigerating engine.

6 Feed engines.
2 Hot-well engines.
4 Bilge engines.
6 Furnace air-pumping engines.
6 Ventilating engines.
2 Reversing engines.
6 Double-cylinder ash hoists.
2 Double-cylinder coal hoists.
1 Capstan engine.

The armament consists of eleven 6-inch, eight 12-pounder quick-firing guns, and a number of smaller machine guns, 2 submerged torpedo tubes, and 8 torpedoes.

The engine-room staff was as follows:—

OFFICERS.

1 Chief engineer.
1 Engineer.
2 Assistant engineers.

(One assistant engineer had only two years' sea experience and the other none, he having just left Keyham college.)

ENGINE-ROOM ARTIFICERS.

2 Chief engine-room artificers.
4 Engine-room artificers (3rd and 4th class).
3 Acting engine-room artificers (4th class).

*N.P.*—An acting E.R.A., 4th class, is one who does not possess a stoke-hold watch-keeping certificate, and generally has not completed one year's service.

Only one artificer had any previous experience of Belleville boilers or of the ship.

The chief E.R.A. was a boiler-maker, one E.R.A. was a blacksmith, another a coppersmith, and the remainder were fitters; but of the entire number of E.R.A.'s only three had any previous sea experience.

two months. Minor troubles arose in connection with the boilers and machinery generally, but the staff was neither adequate nor sufficiently competent, as a whole, to cope with the difficulties effectively, and the entire work and worry involved fell upon the few experienced men who soon became physically exhausted, and, as a consequence, the troubles multiplied. The inexperienced men did their best, but they were of course, under the circumstances, of but little real assistance. The chief engineer and his assistants did all that men could do up to the limits of physical endurance. The chief became seriously ill, and in the course of a short time many of the other officers and leading engine-room ratings became incapacitated. The depletion of the experienced and capable members of the engine-room staff was naturally attended by increased liability to break down, and accident followed accident until the engineering department was in a complete state of collapse. During the later and more acute stage of the troubles, lieutenants were stationed in the stokeholds, presumably with the idea that, by the exercise of the superior authority of the executive officer, they would be able to keep the men under control, and check any tendency to demoralisation which might have been developed by the severe and prolonged strain to which the men had been subjected. This object would appear, however, to have been defeated by the exacting demands made upon the time and attention of these executive officers by the task of avoiding ashes and hot water under foot, and boiling water and escaping steam overhead. Courage is only comparative, and is largely a matter of becoming habituated to special conditions and environment. An executive officer may be brave and undeniably capable on the quarter-deck, and yet be ridiculous and redundant in a sorely stricken boiler- or engine-room. Escaping high-pressure steam and scalding water possess terrors which may be demoralising to a man who has trained and disciplined himself to regard the possibility of dismemberment by shell fire with philosophical stoicism.

This is another proof of the necessity for granting to engineer officers complete executive control over all men deputed to perform duties in engine- and boiler-rooms or bunkers, no matter whether they be drawn from the seamen ratings, or whether they are regular members of the engine-room complements.

This complete breakdown of H.M.S. "Hermes," attended as it was by the placing of the ship and its crew in a position of some peril, is by no means a solitary instance of the failure of our most modern types of war ships to maintain efficiency throughout voyages of even the most moderate duration. Yet with a fatalism which is incomprehensible, and—from the national point of view—intolerable, the Admiralty does not take, or even contemplate, intelligent measures to cope effectively with the serious difficulties with which it now finds itself face to face.

Any system of naval administration must be hopelessly defective which can result in the commissioning of ships so excessively liable to serious breakdowns as typical ships of different classes, representative of the whole of our modern fleet, have proved themselves to be, and under which those ships are sent to sea with engine-room staffs that are known to be inadequate in numbers, skill, and experience.

In these days of false sentiment and spurious humanitarianism, the popular scapegoat for all sins of commission or omission, in departments of state, is that nebulous and impersonal entity known as "the system." It must, however, in fairness to the present Board of Admiralty, be admitted that, the existing difficulties are the result of the perpetual failure of successive preced-

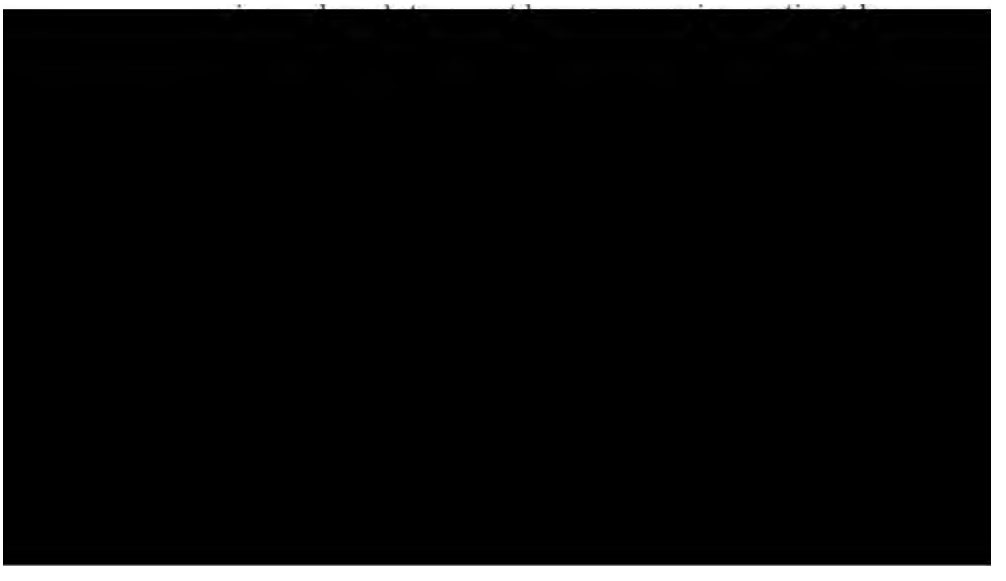
ing Boards of Admiralty to realise the fact that the revolutionary change from sail and smooth-bore muzzle-loading cast-iron guns to steam propulsion and highly mechanical armament, demanded corresponding drastic and far-reaching changes in the constitution and training of the naval *personnel*. The present Board of Admiralty has been unfortunate in succeeding to power and responsibility, to reap the whirlwind, at a time when the evolutionary process has reached its most critical stage.

In time of peace, breakdowns of our war ships simply involve the loss of money, and the physical collapse of a proportion of the *personnel*; but in time of war a series of such accidents could not fail to be a serious national disaster, and might even imperil the very existence of the empire. It is therefore imperative that the primary causes of the present dangerous inefficiency should be completely removed, and that a more liberal and enlightened policy should be adopted in the administration of the Navy.

It is a waste of public money, and a betrayal of public confidence, to build ships, unless steps are taken to ensure, so far as human knowledge and foresight will permit, that each ship when completed and manned will be completely effective. The mere construction of ships does not necessarily create naval power which has any existence outside the world of ink and paper, and until there is some indication that intelligent measures are to be taken to render our existing ships really efficient, it is folly to speculate on the value of the increased national insurance afforded by the additional ships now being built. When these new ships are completed it will be impossible, under the existing conditions, to provide them with the complements of experienced engineer officers, thoroughly skilled artificers, and trained stokers, necessary to convert them into efficient fighting units.

In the course of a recent discussion at the Royal United Service Institution on a paper entitled "The Training of Seamen," by J. R. Thursfield, Esq., some interesting revelations were made of the unfortunate attitude which many representative naval executive officers of high rank take up towards the important questions at issue relating to the engineering branch. Admiral Sir John O. Hopkins, G.C.B. (late Commander-in-Chief in the Mediterranean), said:—

> "The officers learn a smattering of engine work, but they should be in a position to take their place as engineers if called upon. I remember what the Khedive of Egypt did when he was bothered by his engine-drivers for more money. He said, 'Very well, I will give



The first portion of this utterance, coming from an officer of such mature experience and responsible rank, tends to create a feeling of despair as to the possibility of the adoption of a liberal and enlightened policy by the Admiralty; and it is indeed a happy circumstance, on which the admiral is to be congratulated, that he immediately followed it up by a statement indicative of a more reasonable frame of mind, and suggestive of the latent possibility of his ultimate complete conversion to that line of policy which can alone provide our ships with an efficient *personnel* capable of realising their full fighting values.

Captain A. C. Corry, R.N. (H.M.S. "Camperdown"), in the course of a somewhat involved contribution to the discussion, made the following extraordinary and contradictory statements:—

> "The life of the seaman or officer on board a modern steam man-of-war is about as much hedged in by humanly invented pressures as that of any man in the world. Not only is he amenable in the last resort to the ordinary laws imposed upon his countrymen, but he is surrounded by a network of highly artificial pressures which affect his smallest movement. Now, the effect of these pressures continued over a long period is to produce a certain set of qualities, good and bad. He comes in time to look at life and at his business from the steamship and machine point of view, and he becomes, of course, daily more incapable of viewing his profession from any other point of view than that of the mechanic or mere artilleryman. The sea he may neglect. *That is dealt with for him by the constructor and the engineer. The wind and weather are no concern of his; the engines drive him against both he knows not how. There is no need for him to know the capacities of every man upon the lower deck and every officer above him.*"
>
> "Another question which has been raised in this discussion is that of the necessity, possibility, and advisability of giving what is called 'executive rank' to the class of officers now known collectively as the 'Royal Naval Engineers.' What is the meaning of the word 'executive'? Does it imply merely, as many persons seem to think, the wearing of more gaudy uniforms, the enjoyment of a higher social position, and the drawing of a higher scale of pay? If this is all that the naval engineers want, it is certainly not for me to wish to refuse it to them. But their claim to 'executive rank' involves a far higher pretension than this. What is 'executive,' and what are the attributes that it implies? It is a demand for power to 'punish their own men.' This matter is discussed as if anybody is competent to punish; the fact lies that no art requires a more searching and thorough training than the art of justly awarding punishment. The demand of Royal Naval Engineers is exactly like a demand that every employer of labour throughout the country should be allowed to exercise the functions which are now the exclusive property of the magistrate and judge. Punishment, indeed, mere punishment, the awarding, rightly or wrongly, of cells or other penalty, is the easiest thing in the world. But just punishment is, equally, probably the hardest. To give a man ten days cell is easy enough for any man; to weigh and balance the evidence upon which he is to be, or has been, convicted, is entirely another thing. The glory of the 'executive officer' is that he shall be a man in whose hand sane and reasoning men will gladly place their lives at the moment of trial. If the Royal

> Naval Engineer officer wishes to do this, and hopes ever to do it thoroughly, he will find that, in learning this trade, he will have but little time indeed left for acquiring also his own."

On the one hand, this executive officer bears testimony to the important influence of the mechanical elements of the ship's constitution, and in an unwonted spirit of self abnegation owns right up to the fact that the constructor and the engineer take the heavier portion of the burden of responsibility from off his shoulders; and, on the other hand, he refuses to grant to that highly responsible officer, the naval engineer, that power to punish his departmental subordinates which is necessary to give him proper authoritative control. Is it not a palpable absurdity to withhold from responsible engineer officers of mature age, who have spent their whole lives in managing men, a power which is granted to mere youths in the executive branch? and that on the untenable ground that the training of the former prevents them from acquiring even in long years the sense of justice and proportion with which the young executive officer is credited, apparently as a heaven-born gift. Captain Corry is particularly unfortunate in stating that "the demand of Royal Naval Engineers is exactly like a demand that every employer of labour throughout the country should be allowed to exercise the functions which are now the exclusive property of the magistrate and judge." I venture to think that the naval engineers would be only too grateful if they were endowed with the ample powers of punishment enjoyed by employers of labour, who, amongst other means of dealing with offences against their interests, can instantly dismiss any incompetent or insubordinate employee. It is, however, scarcely worth while to subject such nonsense to destructive analysis.

The root of the whole difficulty lies in the fact that, at the present time, when engineering *matériel* has risen to a position of supreme importance as a component of naval power, a fanatical attempt is being made to maintain the engineering *personnel*, which is its essential complement, in a position of inferiority and executive powerlessness, which bears no relation to its present functions and responsibilities, and is based on conditions which have long ceased to exist. The fighting value of a modern warship is determined by the possession of a variety of qualities, the most important of which are dependent for their existence upon the efficiency and workability of the propulsive machinery and the mechanism of the armaments, for both of which officers of the engineering branch are now responsible, and for which officers who are engineers must always be responsible. The unjust and prejudiced policy of

expect that the well-bred, high-spirited and capable youths who are therefore alone fitted to become efficient engineer officers will willingly enter a service where they will be subjected to continual annoyance and humiliation, and where their ultimate grave responsibilities will be unaccompanied by corresponding powers of control.

There is a tendency on the part of some of the opponents of reform to make capital out of certain statements made by Rear-Admiral Melville (in his able and remarkably frank report for 1900, as the chief of the Bureau of Steam Engineering of the U.S. Navy) with reference to the unsatisfactory working of the new Personnel Act, by which the former Line and Engineer Corps of the U.S. Navy were amalgamated. There is, however, no justification for interpreting the words of Rear-Admiral Melville as a condemnation of the enlightened and liberal policy of which the Personnel Bill was the practical expression. In order to prove this point, I cannot do better than quote Rear-Admiral Melville's own words:—

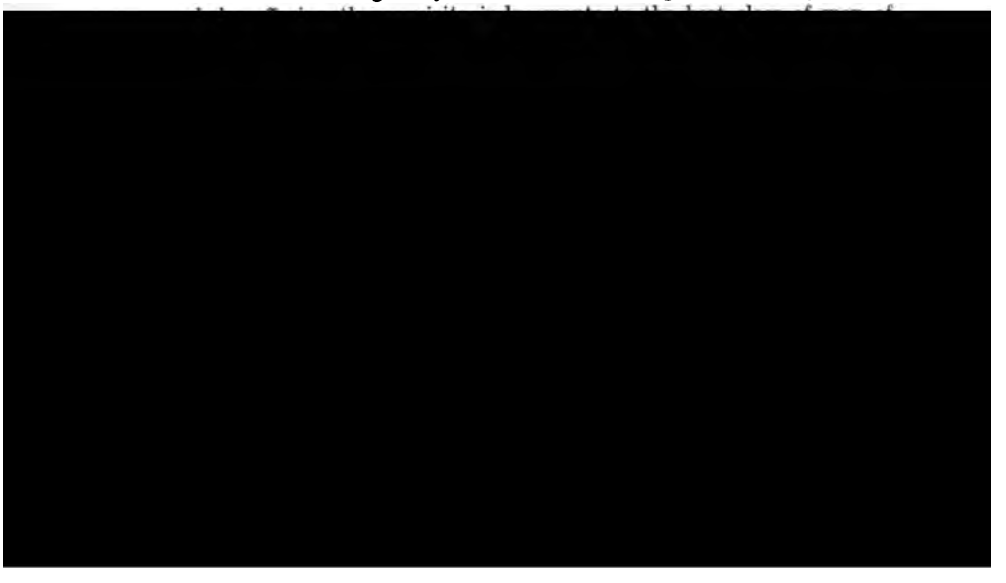
> "I am fully aware of the futility and folly of decrying legislation simply because the desired results therefrom do not promptly materialise, but surely time enough has now elapsed since the enactment of the reorganisation scheme to make criticism of its effects upon the navy both proper and important. To any close observer it is convincingly evident that either the scheme was a mistake, or that the proper course has not been taken to carry out its intent.
>
> "I am free to acknowledge that the events of the past year have brought only discouragement to those most deeply interested in a successful outcome of this new law, *but I am equally candid in the belief that the cause of this discouragement lies not in the scheme itself, but in a lack of full appreciation on the part of the department (navy department) of the urgency of the need for haste*, not only in providing the fullest opportunity for the acquirement of practical engineering knowledge on the part of the younger officers of the former line, but in enforcing their embracement of this opportunity in the most effective manner by departmental orders. It will not do to depend upon unaided individual enthusiasm, or details occasioned by the necessities of particular ships, such a course merely temporises with the present needs, fails in any rational degree to increase the force of navy engineers (even should it suffice to replace the annual loss), and is hopelessly ineffective to secure the most desirable results in the shape of a speedy acquirement of general knowledge of engineering on the part of the new line as a whole."

And then further on in the report:—

> "Regarding the engineering departments of ships at sea in times of peace as well as of war, compare for a moment the advantage of a battleship depending for the full and proper operations of her motive power upon the knowledge of a single officer, the chief engineer, with that of another ship of the same class, whereon any one of the line officers could in an emergency take efficient charge of the machinery and staff, indeed, assume and completely fill the position of an expert in that department. The ideal condition of the latter is what we are now striving for, since engineering knowledge has been recognised as of the most vital importance in the service, and it is to the realisation of this I still hopefully look despite the many visible obstacles."

In reading Rear-Admiral Melville's valuable and lucid report, one cannot help feeling that it would be to the advantage of our public services, and therefore of the nation, if it were possible for the heads of our naval departments to make public, in the same complete, frank, and decisive manner the results of each year's working, and the bearing which the experience gained had upon the creation of greater efficiency. One inestimable advantage attending such published reports lies in the fixing of the responsibility upon individuals rather than upon an unarraignable and intangible system. That the engineering difficulties in the Navy, with which we are now face to face, are typical and not accidental; that they are simply an acute and critical stage in a process of evolution, and not merely the outcome of certain special features of our naval administration; is proved by the fact that the same difficulties are arising in all the progressive navies of the world. The U.S. Navy was the first to reach an acute stage of the trouble which, in the judgment of the very progressive and decisive American people, demanded the immediate application of measures for its redress. We appear to be the next to experience the grave dangers attending the failure to harmonise *personnel* and *matériel*. The others will undoubtedly follow in due course, and in view of the vast amount of world-wide attention which the whole subject is now attracting, progress is likely to be rapid, and we must take care that we are not left behind in the race for the acquisition of the enormous advantages which, in warfare, will accrue to the navy possessing the most efficient organisation.

The first step towards reform is a frank and intelligent recognition of the obvious fact that the great changes of the last fifty years, under which our warships have become floating machines, necessarily involve sweeping changes in the organisation and training of the naval *personnel*. The required standard of increased efficiency may perhaps entail some additional expenditure, but there are so many possibilities of effecting economies by means of reforms in our whole system of naval administration, that it would appear more than likely that vastly increased naval efficiency could be obtained at an annual expenditure not exceeding that which is at present incurred for the maintenance of a navy which is in a chronic state of unpreparedness for actual warfare. In our dockyards, the cost of production could be greatly reduced, and enormous sums of money saved annually, by the erection of modern tools and equipment, and the adoption of an organisation and methods more nearly akin to those obtaining in the commercial engineering world, and which have been evolved under the law of the survival of the fittest. Some of the savings thus effected could be advantageously devoted to increasing the efficiency of the



everything is now done on board a man-of-war by machinery; manual labour is nothing; and the tendency is to increase the machinery, and to do nothing by hand which can be done by steam, electricity, or hydraulics. Not only the motive power, but the fighting power of our ships is all machinery.

"In the old days 'Jack' could repair all ordinary damages himself, and by the exercise of 'his profession' he could keep the ship as a 'going concern' for many months, and sometimes for years, without falling back upon a dockyard. Now he has practically nothing to do with the up-keep of the ship, because it has nothing to do with what we are still asked to believe is 'his profession,' *and the ship can only be kept as a 'going concern' by the engineers, the E.R.A.'s, the stoker-mechanics, the armourers, the specially instructed electricians, and in short, by that large class in the complement of a warship which we may properly call artificers.*

"These men and these men alone can maintain for one week, or for one day, the fighting efficiency of a modern battleship or cruiser, or even a torpedo-boat destroyer, and the consequence is that 'Jack' finds his general utility impaired because he is not a mechanic; his education has been faulty, and he has *not* learnt 'his profession,' so Sir Gerald Noel and some of his friends propose to improve his education by sending him to battle with the elements in an obsolete type of ship. This I consider to be illogical, because I see that 'Jack's' power to defeat the enemies of his country is entirely dependent upon his ability to manipulate skilfully various delicate machines (including the guns themselves), which require considerable mechanical knowledge and skill to work them to the best advantage.

"*Already the engineers are calling out for executive rank and executive titles. This is quite natural, as they see that they do most of the work, and that the maintenance of our modern ships in a state of fighting efficiency is the business of mechanics and not of sailors. I do not think the engineers will get their wish just at present, but this agitation is a sign of the times which must not be ignored;* and it is not difficult to see that unless our Executive—both officers and men—receive a more mechanical training than they do at present, they will be gradually ousted by the engineers and artificers. The law of the survival of the fittest is a universal one, and the Navy will be no exception to it. The 'sailor,' as we have hitherto known him, cannot survive long, as there is no place for him on board a modern man-of-war. Steam and machinery have battled with the elements, and defeated them far more signally than ever the 'Jack Tar' did in his palmiest days, and the caricature of him which we have been vainly striving to keep up for the last twenty or thirty years must now pass away.

"I do not feel called upon to produce forthwith a cut-and-dried scheme for our future training service; but that a complete revolution in it, from the day the boys are first entered from the shore, is absolutely necessary I have no doubt, that is to say if we are to keep pace with the times, and not see ourselves surpassed by other and more intelligent nations while we are crying over spilt milk.

"That the new training must be largely of a mechanical nature seems to me to go without saying, and that the manipulation of masts and sails can have no logical place in it ought, I think, to be equally obvious to all unprejudiced minds."

On the 12th of this month Admiral Sir J. O. Hopkins, G.C.B., communicated to the Royal United Service Institution a most important and pregnant paper, entitled: "A Few Naval Ideas for the Coming Century." It also cannot fail to be of deep interest to all interested in the great question which we now have under consideration, to read the following views expressed by Admiral Hopkins:—

> "And now let me touch on the vexed question of the position of the engineers, and suggest that the time has arrived to accord them executive rank.
>
> "Their duties are purely executive and should be recognised as such, and the recognition cannot, in my opinion, clash in any single instance with the other executives, as their sphere of duty is so clearly defined, and an engineer would as little expect to be put in charge of the navigating or officer of the watch's duty as would these officers of being put in charge of the engines.
>
> "Then as regards power of punishment for delinquencies committed by stokers in the engine and boiler-rooms, why should not chief engineers have the same power of minor punishment allowed them as a commander, second-in-command, a first lieutenant, or, to quote an analogous case, a captain of marines for military offences, under the same restrictions as to quarter-deck investigations, etc.? If this were permitted it would tend largely to improve the chief engineer's position and strengthen his authority. It also appears to me that the time is at hand to train a certain number of the bluejackets to stoke.
>
> "Circumstances may arise in war time or seasons of epidemics when a long run at full speed cannot be maintained without assisting the engine-room party from deck, and then the advantage of the specially-trained sailor-stoker will be very conspicuous. As a coal trimmer also he will often be useful and obviate the present arrangements of picking up men for this duty haphazard and often unwilling workers. The men so trained to be paid a retaining fee as in other cases."

Such utterances from such quarters may be regarded as marking the birth of a new epoch in the history of the British Navy, and it is to be sincerely hoped that young officers of the executive branch will not fail to follow in the footsteps of those senior officers of high rank who, in spite of all the deterring influences of that conservatism and affection for the traditions of

# APPENDIX B.

MEMORANDUM submitted to Sir Fortescue Flannery, M.P., and the members of the House of Commons constituting the Deputation to the First Lord of the Admiralty, by the North East Coast Institution of Engineers and Shipbuilders, Newcastle-upon-Tyne, the Institute of Marine Engineers (London), and the Institute of Marine Engineers (South Wales Branch), with reference to the present unsatisfactory condition of the Engineer Branch of H.M. Navy.

As the result of careful consideration and full discussion of the accompanying papers by Mr. D. B. Morison, vice-president of the North East Coast Institution of Engineers and Shipbuilders, the above-named Engineering Institutions deem it their duty to record and submit their opinion, that the present constitution and organisation of the Engineer Branch of the Royal Navy does not admit of it efficiently fulfilling its important functions.

The causes of inefficiency may be divided into two classes: (1) those which create dissatisfaction and deter the enlistment of desirable candidates, and (2) those which relate to the numbers, training and organisation of the engine room complements.

We are of opinion that the primary cause of the unpopularity, inadequacy, and consequent inefficiency of the engineering department is its inclusion in the Civil Branch of the Service, whereby the executive authority and status of its Officers are rendered incommensurate with their duties and responsibilities.

We therefore recommend that the engineering department be embodied in the Executive Branch of the Service, and that its officers be endowed with executive rank, accompanied, however, by executive control restricted to their own department.

The Engineer Branch being a large and important factor in the war efficiency of the Royal Navy, it would appear that it should be adequately represented on the Board of Admiralty.

In view of the technical nature of the issues involved in Courts Martial affecting the engineering personnel, such Courts should comprise a proportion of Engineer Officers.

The existing system under which Junior Engineer Officers are appointed "in lieu of" Senior Officers, and are thus called upon to undertake the duties and responsibilities properly attaching to the higher rank, without receiving that rank and the corresponding rate of pay, is obviously unjust, and should be suppressed.

The proportion of Engineer Officers of higher rank than Fleet Engineer is at present discouragingly small. We are also of opinion that some attempt should be made to render the Engineer Branch more attractive by a revision of the scales of pay and pension.

In view of the rapid evolution which has taken place during recent years in engineering as applied to naval purposes, we are strongly of opinion that the whole question of the education and training of the engineering personnel should be thoroughly investigated.

The total numbers of the trained personnel of the Engineer Branch at present fall so far short of the requirements of the Service that it is impossible to provide ships in commission with engine room complements which are adequate in numbers, skill, and experience.

Some of the causes above referred to have so far discouraged candidates, that the number of entries into the Engineer Branch through the normal channel has decreased to a dangerous extent, and the Admiralty, to make good the deficiency, have had to resort to expedients which have lowered the standard of the candidates, and tended to undermine the efficiency of the Branch.

The important duties of the Artificer ratings in modern war-ships can only be efficiently performed by thoroughly skilled and experienced mechanics, such as the existing conditions of service have failed to attract in the required numbers; we, therefore, submit that increased inducements should be offered in respect of pay and accommodation.

Signed—

| | |
|---|---|
| For the North East Coast Institution of Engineers and Shipbuilders. | HENRY WITHY, President.<br>D. B. MORISON, Vice-President.<br>JOHN DUCKITT, Secretary. |
| For the Institute of Marine Engineers, London. | JOHN CORRY, President.<br>JAMES ADAMSON, Hon. Secretary. |
| For the Institute of Marine Engineers, South Wales Branch. | SIR THOMAS MORRL, President.<br>SIR JOHN GUNN, Past-President.<br>THOMAS A. REED. |

15*th July*, 1901.

## APPENDIX C.

### REPORT OF DEPUTATION TO THE FIRST LORD OF THE ADMIRALTY IN REFERENCE TO THE CONDITION OF THE ENGINEER BRANCH OF H.M. NAVY.

A Deputation, constituted of Members of the House of Commons and representatives of various Engineering Institutions, met the First Lord of

Mr. Chas. H. Wilson, and Mr. Gustavus W. Wolff. The following gentlemen also attended the Deputation:—Mr. Henry Withy, President, Mr. D. B. Morison, Vice-President, and Mr. John Duckitt, Secretary of the North East Coast Institution of Engineers and Shipbuilders; Mr. John Corry, President, and Mr. Jas. Adamson, Hon. Sec., of the Institute of Marine Engineers, London; Mr. T. W. Wailes, Vice-President, Mr. Thos. A. Reed, of the Institute of Marine Engineers, South Wales Branch.

Lord SELBORNE (with whom were Admiral Lord Walter Kerr, Rear-Admiral Douglas, Mr. Arnold Forster, Parliamentary Secretary; Rear-Admiral Fawkes, Private Secretary; and Sir John Durston, Engineer-in-Chief of the Royal Navy), in opening the proceedings said—I am here to-day as a listener. I do not propose to make any statement to you at all, though I may ask some questions; therefore I hope everything you have to say you will take this opportunity of saying.

Sir FORTESCUE FLANNERY, who introduced the Deputation, said—Lord Selborne, as a preliminary to the questions which have been raised and the speeches which will follow, I may explain, in introducing this large and influential Deputation, that its members are here in sympathy with what they believe to be necessary improvements in the conditions of naval engineers, but they are not here for that reason alone. The reason that this Deputation is here is because they believe that improvements in the conditions of engineers' service are necessary to make the fleet as thoroughly and as completely equipped as it ought to be. It is fifty years ago since the steam branch of the Navy was established, and the engineer officers of to-day are of an entirely different class from the workmen, who were, in the first instance, entered to take charge of the engines of His Majesty's ships. Not only are they of a different class, but they have increased enormously, both as regards the engineers themselves, and the men placed under their immediate charge. That is the case, because, as your lordship is thoroughly well aware, the *personnel* of the engine-room at present is about one-third of the entire *personnel* of the whole fleet. Now, my lord, the question which the Deputation would like to put as clearly as may be before your lordship and your colleagues, is whether or not during that fifty years the successive changes which have taken place in the organization of the engineering department have been such as are required by the improvements of the department and such as make it at the present time as completely equipped as it ought to be. The Deputation will submit, my lord, that in some respects that development has not been complete. They will suggest to you in the first instance that the number of engineer officers is too small. (Hear, hear.) And upon that statement, be it right or wrong, I propose to say that the whole gravity of this question turns. We believe it is common knowledge throughout the fleet that the number of engineer officers is too small and that the establishment of engineer officers which the Admiralty in its wisdom desires shall exist, is not complete. Your lordship is familiar with the fact that there are two methods by which engineers are entered in the Navy. One is through the Engineering College at Keyham and students are trained there; the other way is by what is known as the "direct-entry" system, under which engineers who have been trained in workshops outside the Admiralty service are directly entered from that training to the Navy as engineers. I venture to remind you that the examinations at Keyham have been lowered, and that recently instead of sixty per cent. as the standard number of marks required to be obtained to

justify the engineering students being entered, fifty per cent. has been adopted, but that is only a very trifling statement compared with others, which I shall venture to put before your lordship, in support of the allegation that the Navy is short of engineers. Last Christmas, my lord, there were 200 vacancies to be filled in the engineering branch of the fleet, and there were nine candidates who offered themselves for examination to fill these 200 vacancies. Three entries resulted from the examination of the nine candidates. At Easter there was one candidate, and I congratulate the commissioners on being able to pass that one candidate into the fleet, and he was entered without any delay whatever. Then a fortnight ago there was another examination before the Commissioners, and fourteen candidates sat for examination for direct entry; four were passed and accepted and ten were rejected upon examination. Now, my lord, what becomes of those ten? That is, I venture to suggest, one of the most striking illustrations of the case which the Deputation would venture to put before your lordship. Those ten rejected candidates were offered commissions as engineers for temporary service in the Navy, and I sincerely hope they will improve and become useful and efficient officers. Assuming that the information upon which I am making these statements is accurate, and I believe it to be so, does it not prove—to demonstration, first of all, that an insufficient number of candidates come forward in response to the announcements of vacancies, and even those candidates who are not entirely qualified by examination, however qualified in other respects, are, under pressure of circumstances, accepted in some cases by the Admiralty? Then, my lord, regarding the agencies in Liverpool and in another seaport which have been established by the Admiralty for the purpose of inducing mercantile engineers and others to offer themselves for commissions in the engineering branch, I believe I am correct in saying that these agencies have not been satisfactory in their result. Now, my lord, the reason that I have ventured, perhaps with too much emphasis, though I hope not, to dwell upon this fact as to the comparative dearth of engineering candidates is that when your lordship's attention is called to the necessity for making a change, you may see that the basis upon which the Deputation rests, and upon which their opinion rests, is the basis of making the Naval Service, as regards the engineering branch more satisfactory and more attractive to the best men, so that so far from there being a dearth there may be a plethora of first class engineers as candidates for the honourable position of engineer officers in His Majesty's fleet. I remember, before the outbreak of the South African War, there were five candidates for every position which could be given in the

the Royal Engineers. A separate corps was formed, and they have produced from that branch of the service some of the most eminent officers and some of the best men. In the case of the marine light infantry you have exactly a parallel condition of things to that which the Deputation would suggest for the favourable consideration of the Admiralty. In the case of the Royal Marines you have a separate corps: the officers have proper sufficient distinguishing titles—colonels, captains, lieutenants, and so on, of the Royal Marines, who have complete control over the discipline of their men, always, of course, under the full authority of the captain and their superior officers, and who have no possibility whatever, of hoping to succeed to the command of the ship. One of the objections to rating engineers executively has been a statement that the engineers would have the ambition to command the ship, and would not be fit to do so. My lord, there is no such idea in the minds, either of the engineers themselves, or in the minds of their friends who are pushing this question. Just as the officer of the Marines in His Majesty's ships would be ineligible for the command of the ship under any ordinary circumstances, so would the engineer officer be ineligible in a like degree.

Lord SELBORNE—Does not that really point to the fact that the Royal Engineers do not really form a precedent on all fours?

Sir FORTESCUE FLANNERY—The precedent, so far as the Royal Engineers are concerned, was that a change had taken place by the institution of a separate corps, and that from being an unpopular section of the Service, it had become most popular; that was the parallel. Then I went on to an entirely different corps—the Royal Marines, and I desired to suggest that the status of the engineer may be practically identical with the status of the Royal Marines, in regard to the control of the engineer officers over their men, and in regard to the ineligibility of their admission to the command of a ship. My lord, the engineer officer at the present time suffers under enormous disabilities as regards the control of the men who are under his care. Take one illustration alone: a stoker of to-day is a fighting man; he has not only to work at shovelling on coal, but he has the duty of firing and of using the cutlass. Does it not seem extraordinary that for the purpose of being taught this drill, he is taken away from the control of the engineer, who is responsible for his discipline, and put under a man for a time, who may be a subordinate officer of the executive branch, whose duty is limited to teaching him his drill. My lord, I venture to say that the ordinary stokers and firemen, who represent also one-third of the whole, I venture to think that these men go back from the drill to the control again of the engineer with very much the same feeling felt towards civilians, and with very much the same groundwork of disrespect towards the authority of the engineer officer, as arises in the mind of a man who has fighting duties to perform in respect of the man who has no fighting duties whatever.

Lord SELBORNE—What proof have you to bring forward for that very strong statement?

Sir FORTESCUE FLANNERY—My proof is that possibly fifty of the engineer officers—whom your lordship will understand I could not name—have conversed with me, and have made that statement to me independently; that they have observed that very fact, and that sort of feeling, not in the minds of all those men under their care, but certainly of a proportion of men under

their care. Is there any reason why the engineer who has been adorned with a sword should not have the actual duty of learning and teaching the drill and assist to command the men under his care at the time of their drill, as well as during their engineering duties? I venture to say discipline would be enormously advantaged if that were done.

Lord SELBORNE—Do the engineer officers know anything about drill?

Sir FORTESCUE FLANNERY—To the best of my opinion they are not drilled. The engineer officer has a sword, but I think I am right in saying—though, of course, I am open to correction on these points by those who are more familiar than myself with the details—that the engineer officer is not drilled.

Lord SELBORNE—I do not think you will find that to be the case.

Sir FORTESCUE FLANNERY—In the ordinary course of ships on service, I believe I am correct in saying that such people as the engineer officer, the chaplain, the doctor, and the paymaster, are what are known as "Idlers," and are not part and parcel of the drill of the ship. If I am wrong, I shall be glad to be corrected, but I believe I am correct in making that statement.

Lord SELBORNE—Which is the more important—that a man should do engineering work, or drilling?

Sir FORTESCUE FLANNERY—I should say for the engineer that the most important duty would be engineering work, but, my lord, the engineering work that can be done by his own hands is extremely small, and the utility of the engineer is undoubtedly through discipline. If he has not complete discipline very much within his power, his power is, I submit, limited and his utility is limited. The whole run of what I venture to put before your lordship is, that the more complete the discipline of the engine-room staff under the engineer—with all proper discipline by the engineer to those who are superior to him—the more valuable, I venture to think, and the more effective will be the power of the engineer officers, and indeed all that branch of the Service, if the discipline were improved. Before I sit down I wish to prevent any misunderstanding that there is any desire upon the part of this Deputation to represent the American system. Americans go ahead very fast, and have tried an entire intermixing between the executive officers and the engineer

service, which their service and authority alike demand in justice to them, and still more for the well-being of the fleet, and in order that a proper number of engineers may be obtained for manning.

Lord SELBORNE—I should like to ask just a few questions to enable me to really comprehend your points which you have brought so ably before me. What were these 200 vacancies for which there were only four candidates?

Sir FORTESCUE FLANNERY—It was understood that if as many as 200 candidates at Christmas last were to apply and found to be eligible, that number would be appointed—that appointments would be made for them. I am not in a position to give your lordship my authority for reasons which I think your lordship will understand. That was the general understanding—that 200 appointments would be made if 200 candidates were found eligible.

Lord SELBORNE—Two hundred appointments?

Sir FORTESCUE FLANNERY—Two hundred entries.

Lord SELBORNE—How was it understood? I do not ask for names, but in what manner was it understood?

Sir FORTESCUE FLANNERY—That was generally understood amongst those who have had to do with the recruiting of engineers in the various branches.

Lord SELBORNE—Was there any kind of statement put forward by the Admiralty?

Sir FORTESCUE FLANNERY—Not any that I am in a position to put before your lordship.

Lord SELBORNE—Was there any notice issued?

Sir FORTESCUE FLANNERY—Without a comparison of what was voted, and the list, I could not say.

Lord SELBORNE—Referring to another question you raised, do you suggest—did you suggest—in your remarks that at the present moment the discipline in the engine-room and the stokehold is not satisfactory?

Sir FORTESCUE FLANNERY—I suggest that the discipline in the engine-room and the stokehold could be enormously improved with greater comfort than in obtaining the existing amount of discipline. I suggest that whilst there is much loyalty amongst the engineers, there is a quiet discontent to a large amount amongst them at the present condition of things, which has a restrictive effect upon the recruiting.

Lord SELBORNE—That is not quite the point. Did I understand you to suggest, in referring to the point of discipline, that the discipline between the officers and the men was not satisfactory?

Sir FORTESCUE FLANNERY—I suggest it might be more satisfactory. I do not think there is any want of discipline; discipline is maintained, but it could be maintained very much more satisfactorily by the change suggested.

Lord SELBORNE—You do not suggest there is want of discipline?

Sir FORTESCUE FLANNERY—Oh, no; I do not go so far as that.

Lord SELBORNE—As regards examination, you said that the standard had been lowered—was that entry into the Navy?

Sir FORTESCUE FLANNERY—Entry into the Navy with a period of five years' study. At examination formerly, sixty per cent. of the total number of marks was required, now the standard is fifty.

Lord SELBORNE—Was not that for the selection of those going to Greenwich?

Sir FORTESCUE FLANNERY—That I cannot say. I am, of course, open to correction in details.

Colonel DENNY, M.P.—Lord Selborne, I have but little to add to the very lucid statement made by Sir Fortescue Flannery, but speak with a little authority, having been lately President of the Institute of Marine Engineers, comprising a very large majority of sea-going men; and then perhaps I also speak as a partner in a fairly large engineering firm. I do not propose to enter into any arguments why you do not get the men; it is sufficient that your lordship does not get the men, and will not get them upon the present conditions. Whether the Admiralty desire to get them is another matter, but the conditions offered by the Navy to engineers are not such as to tempt them to come to you in preference to the Mercantile Marine. Their rank is not recognised; they are looked upon tacitly as an inferior class of men, and their status is ignored. The result of all that is, when you come to the country for men you do not get them. I know that recruiting has been established in large towns, but on our own account in our own works our men have been strongly urged to join His Majesty's Navy, but the result of the attempt has been total failure. I think any person with any knowledge of the Admiralty's conditions will admit the supply of men for the engine-room is totally inadequate.

Lord SELBORNE—You must not think that because I do not contradict these statements that I admit them.

confer with them, and who represent the engineers, and give them a sympathetic hearing and a consideration of what really amount to a very serious danger. (Applause.)

Mr. W. ALLAN—My Lord Selborne and Lords of the Admiralty, this is a question with which I can safely say I am acquainted. I can only tell your lordships that, however you may look at the matter, from the letters I have received—many of them from engineer officers, almost from every station in the world, I gather the same complaint and the same tone of dissatisfaction at the condition of things. That is what I find in these letters. It must be borne in mind that candidates and engineers in His Majesty's ships are not the same class of men as they were forty or thirty years ago; it must also be borne in mind that the ships are not the same. It must also be borne in mind that the modern warship is a huge mass of machinery of all kinds. You have all kinds of machinery in these vessels—hydraulic, electric, and steam and every sort of scientific appliance. Then all that machinery is practically under the control, and I would say its destiny is practically in the hands of the engineering staff. Your machinery for turning your turrets and your machinery for working your guns, is practically all in the hands of the engineering staff. Therefore, engineers in your Navy are not the same as they were twenty years ago. What then, are we face to face with? We are face to face with the indubitable fact that your ships have not sufficient engineers or stokers; we are face to face with the fact that the engineers who are present on board ship are at this present moment very much dissatisfied with the condition of things in which they are placed on board His Majesty's ships. The honourable and gallant Admiral shakes his head, and I have discussed this matter with him many times before, many years ago. But I feel we have been too much used to shaking of heads over engineering questions. That is not the way to settle the problem. To settle the problem in the right way, the thing must be grasped from its bottom upwards. How can we get the men and how shall we treat them. We have come to a time now, Lord Selborne, at the present day, we have come to a period when you cannot place a scientific man in an inferior position. You cannot put him in a subordinate position, must make him equal to any officer in the ship; you must give him an executive rank according to the period he has served, and according to the ability he has shown; you cannot get out of it; you must give that man control over his men. The men are taken out of his control for a time and are taught drilling and firing, and when they come down into the stokehold again they laugh at the engineers. (Lord Selborne shakes his head.) I have it in writing—particulars of the condition the engineers are placed in. Many a court martial has taken place for petty insults to an engineer, but they do not report everything; it would never do, and they do not do it. I want to get out of that difficulty and to make the Navy what it should be. We are all Nationalists and Imperialists in this room, and we all want to see a great, strong, bold, healthy Navy; every officer pulling at one rope. At present, the position of the engineers is something which ought to be taken in hand and righted; the matter should be remedied, and could be remedied by giving them executive rank, and making them feel it is something of worth, and that it is an honour to be on board one of His Majesty's ships. That would not affect the discipline at all in anything but an advantageous way. The captain would be the captain, but the firemen and stokers would feel that the engineer was an officer, and a superior officer over them, and an improved system of discipline would thus be maintained. I am fully satisfied, Lord Selborne, that you will

earnestly consider the matter we have brought before you, and I have every confidence in this myself. I may say the same to the Secretary of the Admiralty, and of the other honourable officials of the Admiralty—I have every confidence in them, that they will grapple with subjects and with these matters that tend to weaken the Navy. You cannot get the men; I know the difficulty which has been experienced in this respect. In our own shop we have endeavoured to get lads, when their apprenticeship is out, to join the Navy, but they refuse. I would therefore say, Lord Selborne, that all this shows that the outline you must take, is this, and I say it with all sincerity, you must give these men executive rank. It will not endanger the position of the ship, but enhance it. Give the men a standing and make them feel that the uniform they wear is one to be wisely worn and honoured, and not degraded. (Applause.)

Sir JOHN COLOMB—Lord Selborne, I have been asked to come here to-day and I have with great pleasure, and will now say a few words regarding the Deputation. You, sir, the other day, very properly remarked in the House of Lords how great were the difficulties with which the Admiralty had to deal at the present time. I have heard much about the inefficiency of certain branches in the Royal Navy, and with regard to the particular question now raised, I regard it as one of the greatest difficulties with which the Admiralty have to deal with. I came here to-day because I think the time has arrived for really facing the difficulty in some definite way—in a more definite way at any rate than has as yet been done. There is a good deal of ground to travel over, but I will not occupy your time for more than five or six minutes. Just let me draw your attention to one fact; with regard to the *personnel* of the Navy, and especially with regard to this part of the question—why we have arrived at the present state of dissatisfaction and difficulty. We have arrived at it, I think, through a long series of administrative compromise between the force of sentiment and of tradition on the one hand, and the force of facts produced by the progress of mechanical science on the other. That I take it is the fact. I remember hearing a distinguished Admiral, with flags flying, declare that a naval war could not be carried on with steam; that the "Tea-kettle" as it was called, was useful to overtake an enemy, but the first thing an enemy would do when they came up with it would be to put the fires out. I mention that as showing the force which this tradition and this sentiment—I may call it, had on the administration in past years. Now, sir, in 1858, we had the last inquiry into the *personnel* and organization of the Navy. No

branch, and in 1900, as you know, my lord, it is over 24 per cent. If you have examined the returns you will find in every part of that *personnel* there is—in the engineering department—an increasing ratio; for instance, if you take 1888 to 1900 you will find the increase in the ratio made in those twelve years was a great deal more than that made in the previous thirty. That is how you have arrived at the present state of things. There has been a great numerical increase, but the particular situation of the *personnel* and their position in relation to the fleet is exactly the same, precisely the same as was the case in the days of the old fleet. You have therefore this fact, that the engineering branch is still regarded as a group of civil units put into warships, and has neither obtained organization nor an executive part in the ship's complement complete in itself. That is the position, and I am convinced it is not a satisfactory position with regard to the good of the naval service. It is unsatisfactory I think to this extent—that it really repels more than attracts men from the engineering works of this country. Therefore, sir, I think the time has come for facing this question, not by any revolutionary process, but by such statesmanship as will remedy the difficulties at present raised. I would remind you, sir, that there are a great number of very distinguished Admirals—Sir John Hopkins, Admiral Fitzgerald, Admiral Henderson and Sir Edward Freemantle, etc., who agree. Sir Edward Freemantle said the other day that the great question "above all questions"—to use his exact words, was the question of the amalgamation of the engineer with the executive branch. I cannot go to that extent, and I cannot satisfy myself that the step taken by America has been the right one, but I do certainly think that the time has come for recognising that some such an amalgamation must come about, and we have to try and see how that can come about in the easiest manner and in the easiest way in His Majesty's fleet, and this is the matter to which the earnest attention of the Admiralty is directed. I would submit to the Admiralty for their earnest consideration the fact that the time has now come for instituting an engineering branch as a corps of itself—the Royal Naval Engineers—and treating and regarding it as a combatant branch of the Navy and conferring on it executive functions and responsibility in itself for the special functions it has to perform, and making it an independent body. Then, I think, by taking that course, you would be rendering due importance to the engineering branch of the Navy, and be making it more attractive, and preparing the way for those changes which I think mechanical science will certainly force upon you very soon. To delay making these preparations is not advantageous to the interests of His Majesty's fleet, nor to the engineering branch of the service.

Lord SELBORNE—Another question I should like to ask. Do I understand, sir, that from your point of view the most advantageous solution of the question is amalgamation?

Sir J. COLOMB—I think that will come in the future. I differ from Sir Edward Freemantle in that respect, but it might be developed in the future.

Lord SELBORNE—You think eventually it should be amalgamation. I wanted to ask you about that; you think that establishing a separate corps would assist your desire for amalgamation hereafter?

Sir J. COLOMB—I cannot help thinking so. I think it has this advantage—that it certainly gets rid of many of the difficulties which you have in your

present position, and organises the particular branch. It is too early to deal with amalgamation, but it is easier to amalgamate between two organised parties than with one organised party, and the other disorganised, consisting of scattered units.

Sir FORTESCUE FLANNERY—There are several other members present who are prepared to address your lordship, but I am unwilling that an undue advantage should be taken of this occasion. (Hear, hear.) I will ask Mr. Withy, the President of the North East Coast Institute of Engineers.

Mr. HENRY WITHY—I have pleasure in coming here to support this Deputation. I may say, Lord Selborne, that this plan was fully discussed at a meeting of our Institution, and the view there taken was that certain changes were necessary in the organisation of the Navy and in the status of the engineers. We felt that the position of the engineers should be made more clear, and we believe that the discipline of the engine-room would be much more easily arrived at by giving engineer officers executive rank, than of their having any complaint of insubordination, or anything of that sort referred to the executive branch of the naval officers. I am told that the Royal Marines number 18,000, and that the *personnel* of the engineering branch number 27,000, and I think perhaps that is an argument why the engineers might be made a separate executive body. I do not consider that there will be or would be any friction between engineer officers and Naval officers, or any more than there is between the Royal Marine officers and the Naval officers. The question of the reserve of men for the Navy is important. I am told that there is a reserve list of engineers who may be called upon to serve, but I am inclined to think there will be very great difficulty in getting them, and in time of war I presume they will be all over the country and all over the world. Further, the engineering work on board a line of battleship is so specialised that I am afraid the ordinary engineer of the mercantile marine would hardly be able to take his place on board a line of battleship, or be able to attend to any special machine he might be asked to look after. He would not be acquainted with hydraulic or electrical machinery. Another thing which would unfit him for doing duty on a line of battleship would be that he would probably be unfitted for the discipline, and would find it very irksome, as it would be to the ordinary mercantile marine engineer. The other question which seemed to us of very much importance at our Institution was the training of your engineers.

Lord SELBORNE—In reference to your remarks, do you suggest it is quite impossible to have a reserve of engineers?

Mr. HENRY WITHY—I would not like to say it was impossible. I think they should be men trained in the Navy. (Hear, hear.) I do not think the ordinary engineer on board a mercantile vessel qualified to take charge of the delicate machinery on board a man-of-war. (Hear, hear.) It would be very difficult. I have a good deal of experience, and as years pass by, men get more and more specialised. Men are specialised at hydraulic machinery, or at electrical machinery and so forth, and we have fewer all-round men than we had a few years ago. With regard to the training of the young engineers, our Institution felt that the matter required consideration. We had no suggestions to offer, but we feel that the matter is worth the earliest attention of the Admiralty, and if they are able, the engineering branch of the Service should be made more attractive and more popular, when better men would join. I do not suggest there are not proper men, but there is a difficulty in getting men of

the right class; if the Service was made more popular, better men would join, and there would be more enthusiasm to put their whole interests into the work and do the very best they could. We urge upon your lordship the consideration of our petition.

Mr. JOHN CORRY (President of the Institute of Marine Engineers)—My lord, I had not intended speaking on this subject. I have only recently been connected with the Institution, but as a practical shipowner this is a subject I take great interest in. I know the great importance of having an efficient engine-room staff. In time of peace and war, the chief engineer is the most important man on board your ship, because all the machinery of that ship is under his charge, and if he is not a man of power and ability, or does not know how to use his power and ability, so as to impress the *personnel* of his staff, you will not have that efficiency which is absolutely necessary. It has been said, and said very truly, that the position of machinery has increased enormously. Everything now on board ship is done by machinery, and it requires a very able man, and a very clear-headed man, to be ready and competent at times and under all emergencies, and to make the best of circumstances that may arrive. You must have men of first-class ability, and you must give them that position which their training, their knowledge, and their capacity warrants them in expecting. With regard to economy, we all know how important it is for a ship to be economically managed, and if you have men who do not understand, and cannot understand the engine-room, you have a very inefficient ship, and therefore an expensive ship. With capable engineers, however, everything works smoothly; the whole staff work harmoniously; but you must have the right class of men and you must get the right class of men, and to get them you must give them a position which I think, and believe is, really the thing they require. I think matters have been fully explained already, and that I need say no more. I had not intended to speak, and I trust you will excuse me.

Sir FORTESCUE FLANNERY—There are others who are prepared to speak. I think that now the matter has been fully explained to your lordship, and that probably it will not be necessary for me to call upon anyone else, unless there are any of my honourable colleagues who would wish to speak.

Lord SELBORNE—My time is entirely at your disposal.

Sir FORTESCUE FLANNERY—If there are any of my honourable colleagues who wish to speak, I am sure Lord Selborne will be ready and pleased to hear them. Sir Edward Reed is unable to be present to-day, but writes me a letter from which I will read an extract. He says:—

> "You and the other Members of the Deputation should quite understand, I hope, that my interest in the question of the Royal Naval Engineers is in no way abated, and that I believe the Naval Service is running the greatest risks by withholding from the engineer officers their rights, and that executive authority of engine-room and stokeholds, which are as essential in time of peace as they will be in times of war."

My lord, I think we have said now all that is necessary or proper, in order to fully lay the matter before you.

Mr. MATHER, M.P.—I would just like to add a word or two, although I have not been invited to do so. I would suggest to the First Lord of the

Admiralty this fact, that we have not arrived at any finality in the mechanism required on board. So far as the future is concerned, it is a question of speed which lies at the root of all the organization, I think, on board ship. The fleetest fleet must necessarily be the commanding fleet of the future, and to achieve that end, of course, mechanism of a more and more perfect character will be required as time goes on. Therefore the importance of the engineering staff for a man-of-war, and for vessels of war becomes, and will become, a matter of increasing volume. I venture to think that much of the trouble that has arisen in the Navy of late in connection with the use of the water-tube boilers—if my friend, the honourable member for Gateshead, will forgive me for introducing the point—I think that much of that trouble might have been avoided had the engineering staff possessed that executive rank which would have enabled it to utilise the knowledge of its engineers for the purpose of advising the captain of the ship and others in authority, and responsible for the charge of this branch of the naval equipment; if the staff had had those opportunities, I think much trouble and danger might have been avoided, and many valuable suggestions might have been given from the engineering staff had they possessed that rank and position which would have enabled them to speak to their superior officers.

Another point I wish to lay before your lordship, is that this Deputation is not pleading for a matter of personal vanity. (Hear, hear.) We are not here to express to you that we have as engineers great responsibilities in our profession, coupled with duties of enormous importance, and that that fact is not sufficiently recognised by the Admiralty. It is not upon that point that the matter turns; we urge that if a proper rank was given to engineers and an executive power invested in them, that there would be a largely increased number of men than at present rush to serve His Majesty's Navy. It should be urged that such a position is a highly honourable employment, and from that point of view the question of rank becomes of some importance certainly. We have been told that gentlemen in this room have not been successful in inducing men in their employ to join the Navy, but this would not be the case were it told them that in joining the Navy they would have an officer's rank given them, which the man could follow up and improve according to his ability. That would have an enormous effect upon the *personnel* we are concerned with, and more and better men would be willing to join, if they felt that in doing so they were rendering an important service and filling a responsible position in joining as an engineer in His Majesty's Navy. I would therefore urge upon your lordship to look upon this matter from the point of view of the loyal service rendered to the country by the engineers. They are a profession of men developed by national methods, and a much higher class of men than they were forty years ago. That class of men is certainly required in the Navy in increasing numbers in view of the increasing amount and complexity of the mechanism and the multiplicity of mechanical operations on board a man-of-war, which are being added to day by day and will increase more and more. I think that with the changes as suggested there will be increased utility and satisfaction amongst those who have to serve that department.

Lord SELBORNE—There is a misapprehension in what you said about the Belleville boilers. Engineer officers have had the most ample opportunities either through the captain of the ship or through the engineer-in-chief of making any observations they chose, and that was done from time to time. (Hear, hear.)

Mr. MATHER—They may have the opportunity now, but I am only just pointing out that by introducing this executive power amongst engineers you not only give them the opportunity to make suggestions, but it becomes a matter of direct responsibility.

Lord SELBORNE—Every engineer considers he is responsible for making what suggestions experience suggests; I think he is responsible for that. Gentlemen, I ventured to say when we commenced this very interesting meeting that I was not going to make you any speech, but that I was going to listen, and I shall, with your permission, maintain that line. All that you have said will be most carefully followed and considered by us, though if I do not contradict any of the statements it must not be inferred from that that I admit them. For instance, I must not pass over the suggestion which has been made that the engineering branch of the Royal Navy does not adequately perform its important functions. I cannot admit that for a single moment; nor do I admit for a single moment that there is any want of discipline in the engine-room or the stokehold; I do not think that is really so. I must also at once deny the suggestion that the stokehold and engine-room artificers do not show that strict respect which discipline enjoins towards the engineer officers. Of course, the contention which I think has run through many of the speeches is that the whole Department is undermanned, and that there ought to be a great many more engineer officers in the Navy. That, of course, is a matter of opinion, though I do not admit the fact. It is also perfectly fair for gentlemen of experience to express an opinion, and to say that we admit as officers into the Navy some gentlemen who do not come up to the standard. It is, of course, perfectly legitimate to hold and to lay down that opinion, though I do not admit the truth of it. Again I do not admit that we do not get the numbers that we ask Parliament for, and though we may make our standard easy we get the men up to it, and we get those we ask for according to our standard. The numbers in July were 978, and 963 were obtained, and we expect to make the other 15 up before the close of the year. I only mention that in order to differentiate between what do seem to me to be fair subjects for an expression of opinion, and what represent misrepresentations. There is only one point I wish to refer to, although it has not been alluded to in the speeches that we have heard to-day, but it is included in the Memorandum. That is a suggestion which has been repeatedly made, not only with respect to the engineering branch of the Navy, but in other branches of the Navy also—that there ought to be a representative of the branch on the Board of the Admiralty. Now, that suggestion is only made out of a complete misunderstanding of what the Board of Admiralty is. The Board has not been and never will be a collection of the Heads of Departments, but consists of the Lord High Admiral, or a number of gentlemen selected by the Crown. The Lord High Admiral you might compare to the Secretary of State for War and the Commander-in-Chief rolled into one; those are his functions and what the Board of Admiralty has always been. When it has not been the Lord High Admiral, it has been a number of gentlemen selected by the Crown who hold that particular office under commission. It is open to the Crown to change members of the Board, and to elect members on the Board. The Comptroller, for instance, has been on and off, and when he is on he may be off again. A civil engineer has been placed on the Board at one time, but he is not there now. I merely point to that to show you that it is a misrepresentation to state or to assume that the Board of Admiralty is a collection of Heads of Departments. It is no more that than the Secretary

of State for War and the Commander-in-Chief themselves represent the Heads of Departments. The Heads of Departments—the Head of the Engineers, the Head of the Marines, and the head of any other branch of the Service have exactly the same means, and the same power of representing their case, and of putting forward their points to the Board of Admiralty as the Quarter-master General, the Paymaster-General, and the Inspector-General of the Forces have to the Commander-in-Chief and the Secretary of State for War. Of course, it may be a matter of opinion as to whether or not there should be a collection of Heads of Departments, but that is another point with which however, I do not agree. The point I want to put forward is that to have a collection of Heads of Departments would be to have a complete reversal of the whole of the history of the Admiralty and of its origin. I have nothing more to say to-day, gentlemen, but to thank you for the able and full manner in which you have put your case before me.

Sir FORTESCUE FLANNERY—It now but remains for me on behalf of the Deputation to express our deep gratitude to your Lordship for the attention with which you have listened to every one of our arguments and for the very great courtesy with which you and your colleagues have received us on this occasion.

These remarks were received with applause, and the Deputation withdrew.

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## DISCUSSION.

The PRESIDENT—I have a few letters of apology to read. Mr W. R. Plummer, M.P., writes to regret it is impossible for him to be present, but expresses his sympathy with Mr. Morison's views. Mr. George Macfarlane, of Glasgow, regrets that he is not able to be present, as he has to be in London. Mr. Mather, M.P., is away from home, and his secretary writes to say that he is sorry he cannot be here. I have a telegram from Mr. Robert Thompson, one of our Past-presidents, which says:—"I cannot

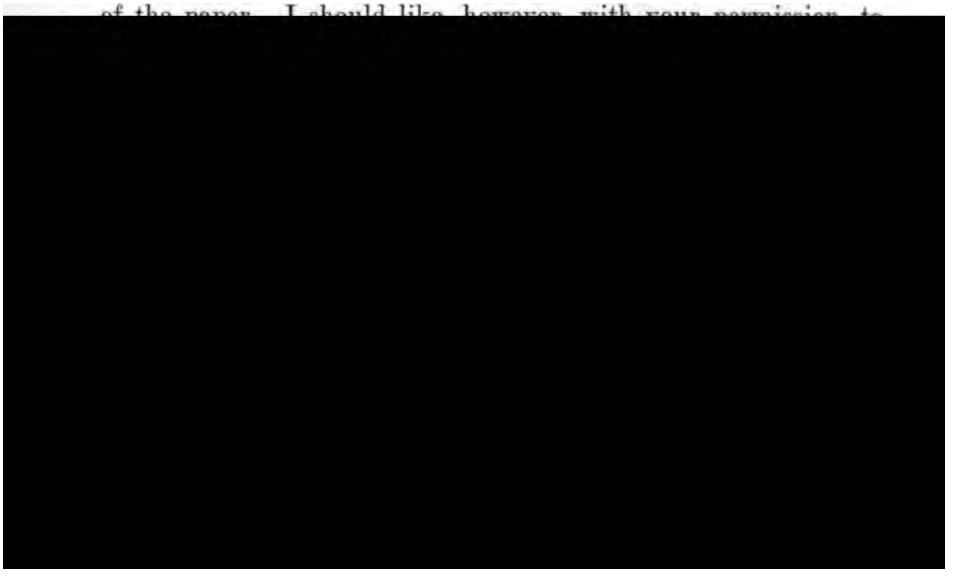
Morison on "The British Naval Engineer," and our best thanks are due to him for returning to a subject of such national importance, for the expectation that the efforts of members of engineering institutions following his first paper would be the prelude to energetic action on the part of the Admiralty, has been grievously disappointed, and anything that has been done has only been trivial and of a spasmodic character, and apparently we are where we were. In the course of the able paper to which we have had the pleasure of listening this evening, Mr. Morison clearly indicates one important direction in which—to quote the words of the Prince of Wales at the Guildhall banquet—"England must wake up," and throws a flood of light upon the fool's paradise inhabited by our somnolent Lords of the Admiralty. The epithet "Somnolent" is, I think, a charitable one, for it would be a grave injustice to attribute "Wakefulness" to them in face of the alarming facts disclosed in the diagrams we have before us, and which have grown under their supervision and are directly and necessarily the result of their policy in regard to the engineering branch of the Navy. Judging from the past, however, the deep sleep of that august body is unlikely to be seriously disturbed unless the members of engineering societies, such as ours, back up the patriotic appeal of the author of the paper. Let us make up our minds to do so with our whole energies alive to the importance of this question, which is the efficiency of the Navy. Our best thanks, I am sure, are not only due but are gladly tendered to him for the trouble and patient research that he has expended in collecting and putting before us this exhaustive, though pitiless exposition of facts and figures. As engineers, we cannot but deeply regret that our brothers in the profession, who have elected to serve His Majesty afloat, should be subjected to such disabilities in carrying out their numerous and onerous duties, and must be concerned to know that the country is not getting even the number of engineer officers and men that the authorities themselves admit are necessary to man and work our ships. It is truly alarming to think for a moment even that our Navy, which is the main insurance for the safety of our person and property to-day, and on which our existence as a nation may some day depend, should have any weakness. We cannot look at a daily paper without this reflection being forced upon us, and so the details that Mr. Morison has brought

before us are lifted away from all question of mere personal, or even professional importance, into matters of national interest. Although not well versed in the history of the Navy, I have been able to follow the growth of the engineering branch, and the worst aspect of this important and complicated question is the fact that it has been under the consideration of the Admiralty several times with no practical result. An Admiralty Committee sat to consider the manning of the Navy over ten years ago, and the result of their deliberations was to reduce the complement over 12 per cent. Since then it has been accepted that assistance in coal trimming is to be rendered, whenever a ship is required to steam at anything above a small proportion of her full speed power, by men whose duty it is to work the guns and supply them with ammunition. What must happen when both the full power of the engines and the fighting of the guns are simultaneously required? Can any thinking man, whether he knows anything about a ship or not, seriously contemplate that we shall fight a bit and stoke a bit, and do both successfully? To put it mildly, is there not a risk of our being unable to do so, and is there any necessity for our running this risk? Suggestions for reform have, time after time, been made by the engineering world and are once again reiterated by Mr. Morison in his paper. There is, as we all know, a repugnance for the word "cannot" on the part of every engineer worthy of the name. It is an essential part of his training to tackle all difficulties and overcome them, and this very quality has, I fear, been traded upon in the case of our Naval brethren, by gradually increasing their duties and relatively reducing their staff in numbers and quality, till the present dangerous state of affairs has been reached, as is instanced by

ling must have an end, for a time will come when we shall not get through, and every day this condition exists multiplies the difficulties eventually to be faced. Mr. Morison now gives us a further insight into the existing difficulties, and it is clearly our duty, in the best interests of the country, to follow his example and not be satisfied until this dangerous state of the engineering branch of the Navy is remedied. As Mr. Morison points out, naval engineers have had serious grounds for discontent for many years, and their claims have been repeatedly brought before the Admiralty Board with little, if any, result, and this magnifies the danger, for no body of men, however loyal, can so efficiently serve when they labour under such disadvantageous conditions. Events move rapidly in these days, and the services of our Navy might any day be suddenly required. The bad moral effect brought about by many years of neglect will take many years of serious attention to remedy. That the effect is extending further is being very strongly emphasised at the present moment by the scarcity of engineer students. So marked is this decline that the Admiralty, as Mr. Morison points out, have had to ask the headmasters of our schools to advocate the engineering branch of the Navy as an opening for the youth of the country. The timely rebuke administered by the headmasters should be a warning to the Admiralty that the British public is awakening to the peril of the naval situation of to-day. Mr. Morison gives a further instance of the short-sighted policy pursued by the Admiralty, when he refers to their recent action with respect to the electrical appliances and fittings on board a warship. Under the best conditions some confusion is likely to occur during a naval engagement, but it is terrible to contemplate the hideous possibilities when confusion has been rendered inevitable by a short-sighted and wrong-headed policy. The sister service has been, and is, on a severe trial in South Africa, and apparently it is the custom, when a breakdown occurs, and some have been experienced in South Africa, to attribute it to a fault in the system hitherto pursued, which breaks down in the hour of trial. A few shufflings of positions amongst those responsible for the system and the incident is considered closed. Surely these breakdowns are due to a want of foresight on the part of men placed in responsible positions, whose duty it is to exercise foresight. We have a system with regard to the engineering branch of the Navy pur-

sued which, as long ago as 1858, the Admiralty were warned against, and now, I may say, universally condemned by engineers. Apparently this system is to be pursued until we have a great naval disaster. Other nations are becoming alive to the necessity of action, for whilst some have decided to form an Engineer Corps in connection with their navies others are considering the advisability of doing so. Let us hope ours will do the same before it is too late. In conclusion, I would personally heartily congratulate Mr. Morison on the courage and ability with which he has tackled what must be a distasteful subject, for it is always more pleasant to praise than to find fault. The facts are marshalled before us in a manner capable of being understood by those to whom engineering and its difficult work is a sealed book. The question of our food supply in time of war was raised and discussed in the House of Commons early this session, and one speaker I saw, remarked that we must depend for our bread and butter in time of war, not on granaries, but on our fleet. Anyone reading Mr. Morison's paper must feel that all is not being done to make this dependence sure.

Mr. J. A. Bedbrook, R.N., Chief Inspector of Machinery (retired), said—This paper I consider a very valuable contribution to the subject of naval efficiency. I think, too, that the author is to be congratulated upon the clear and lucid manner in which the facts are brought forward, and that without any exaggeration. It expresses the views I hold on this question in better language than I am able to command, and it also treats the subject in a very able and comprehensive manner, so that there is little I can add to enhance the value



without saying, that where the competition for entry is less keen, more lads of less ability and intelligence gain admission. The same is more marked with regard to engine-room artificers. The standard is practically lowered, for when I had the duty of examining candidates about 28 years ago we had a very keen competition for vacancies. The men entered were not only highly skilled workmen, but men of superior intelligence. Now, unfortunately, the number of candidates do not anything like come up, and sometimes are almost *nil*, for the number of vacancies that exist, and consequently you are obliged to pass those who can merely scrape through—moderate workmen only, who can just do the trial work that is placed before them, and who can just pass the educational requirements. Lastly, the stoker ratings are not of the same physique and intelligence as they were. So that one cannot help noticing that, while the Admiralty specify, when ordering ships and machinery, that every part shall be of the best material and workmanship, they in effect specify that any one is good enough for the personnel of the engine-room. Reverting again to numbers it should be noted that, apart from the lack of men in ships now in commission, the utmost difficulty is always felt in finding sufficient men to fill up the restricted complements of ships for the manœuvres. I can speak correctly on that point, because I happened to be associated with the Manning Committee for some years. Formerly the engine-room complement provided sufficient men for continuous steaming at 70 per cent. of the full power, and extra men for other duties; subsequently the complement allowed was for only 50 per cent. of the full power, and no extra men for extraneous services. But when expostulated with the reply was, "You can always get deck hands whenever you require a higher speed." In peace time we may get the men, but in war time can we get the men? I am bold enough to say that the deck officers will require their men for preparing guns and various other things, and as long as that critical period exists pending a naval engagement we shall not get a man from the deck to assist the stokers below. Besides the difficulty experienced in ships on ordinary service the utmost difficulty is found in commissioning extra ships, such as during the time of the summer manœuvres, when the Navy is supposed to be put into a condition for war time; not only are men taken from many duties for which they are actually required on shore, but

even then ships have to go with still further reduced complements. Another very serious point to consider is this—that having depleted the whole of your depôts or reserve of men we have absolutely no reserves of men or officers to fall back upon should we be engaged in war, when there would be a great wastage of officers and men, and there would be considerably more in the engine-room department in proportion, because they have greater risk. Then on the question of discipline which has been referred to, I am glad Mr. Morison has drawn attention to that point because everyone who has had command of men knows the great difference between a cheerful and willing obedience and a sullen and grudging one. Even the best of men are sometimes tempted to yield to the latter when they feel that their energies are being over-taxed, while the lazy and indifferent will certainly require the exercise of undoubted authority to prevent the appearance of resentment, and these are the men who are ever ready to question the restricted authority of the engineer officer. There is in the regulations some subtle difference made between giving a command and giving an order. An engineer officer belonging to the civil branch is never to command, but he may give orders in his department, and every facility, they tell us, is to be given to the officers to ensure their orders being obeyed. But they are never to give a command. I do not understand the difference myself, but it is so. On the next point, with regard to promotion, Mr. Morison has compared the ages at which engineer officers attain the several ranks as compared with other officers, but I should like to add that it must also be borne in mind that the duties carried out by the engineer officers are performed under conditions which severely tax their physical endurance. It is a different matter serving on deck in the fresh

should receive better pay, rank for rank, considering his high responsibilities. I would just like to put Mr. Morison right on one point. He compared the "Britannia" with the Engineering College at Keyham. He mentions the fact that the Admiralty Superintendent is regarded as the head of the College. Well, so he is, but he forgets to put down that the "Britannia" has a similar head, that is, the Commander-in-Chief at Devonport, who is more than a nominal head, for he exercises a considerable amount of interest in and supervision over the "Britannia." That is a point that should not be lost sight of. The next point upon which I wish to say a few words is the military status in respect to the engineer officer. The *raison d'être* of a ship of war is that it should be a fighting machine, therefore everything in such a ship should be considered from that point of view. This is the case so far as the construction and arrangement of the ship is concerned, but we see that it does not, unfortunately, obtain in respect to the personnel. It is surely an anomaly that anyone serving in a ship of war should be considered a non-combatant. Everyone on board has to do his share in making the ship as effective as possible for attack or defence, but this does not appear to be the view of those in authority when a large proportion of the crew are said to belong to the civil or non-combatant branch, and in effect told that they have no part or lot in furthering the end for which the ship really exists. Surely the nation would expect that the whole of the crew should be available for and capable of carrying out any duties which will tend to place a man of war in the highest state of efficiency as a fighting machine, and that every officer and man on board, whatever his usual occupation may be, should be available for taking part in military operations both afloat and on shore. Especially should the officers and men of the engineering department be considered as combatants who in their usual avocations contribute so large a share in rendering the ship efficient for attack or defence, and as the numbers in the engine-room department form, or should form, a large proportion of the ship's crew, there may be circumstances at some critical moment during an engagement when some of them would be required for service outside the machinery department, that is, for purely military duties; and in the event of a naval contingent being landed for operations on shore, a large proportion of the engine-room complement might be available to

join the contingent. This is not a mere fancy but has actually occurred in every fight we have taken part in. That being so the position of the engineer officer should be such as to demand implicit obedience from all naval ratings, and this is only possible by his being given a military status. It should further be borne in mind that engineer officers have a large number of petty officers and men serving under their orders, and that they, with their men, during their ordinary duties are called upon to submit to risks greater than many others of their shipmates, in view of the probability of the boilers, engines and steam pipes being damaged by shot or shell or torpedo; and the possibilities of the vessel being rammed. I may remark, for instance, in the case of the "Victoria," not in war time, only one engineer officer was saved whereas only one lieutenant was drowned; and we know with regard to the unfortunate men a large proportion of the engineering department perished in that ill-fated ship. It is consequently necessary that the engineer officers should exhibit to their men an example of courage and coolness for the preservation of discipline and the ensuring of prompt attention and obedience to orders, but it becomes difficult to exhibit these necessary qualities if the spirit of these officers is crushed by the continual repression and non-recognition from those in authority. The engineer officers and the engine-room artificers during their junior time, and the stoker ratings during their career, go through a certain amount of drill in small arms, etc., and this might be extended with advantage to the service for both officers and men to give them greater proficiency in small arms practice and they should also be exercised with the larger guns. The proposals to give a military status to the engine-room complements have been stig-

therefore, should officers and men already subject to naval discipline, and already partially instructed in military drill and practice, be made, during leisure from their ordinary occupations, fully competent to undertake military duties when called upon. The engineer officers and the engine-room ratings, I feel sure, will yield to none in their devotion to duty and their loyalty to their King and country. What do you understand by a military man? Most dictionaries will tell you it is a man belonging to the army, but the true definition is a man who bears arms, and whose business and duty it is to defend his country or attack its enemies. It is not only that naval engineers should be classed as military men, but what is quite as necessary is that they should receive the titles indicating their rank. Perhaps I may explain to you what the present engineer ranks are. An engineer student is said to rank with a naval cadet; an assistant engineer with a sub-lieutenant in the navy or a lieutenant in the army; an engineer with a lieutenant in the navy or a captain in the army; a chief engineer with a lieutenant of eight years' seniority in the navy or a major in the army; a fleet engineer with a commander in the navy or a junior lieutenant-colonel in the army; an inspector of machinery with a captain under three years in the navy or a lieutenant-colonel in the army; a chief inspector of machinery with a captain of three years in the navy or a colonel in the army, and engineer-in-chief of the fleet with a rear-admiral in the navy or a major-general in the army. The executive officers in the navy are designated by their titles and their rank is actual, but the rank of the engineer officer is only relative. When an engineer enters the service he is plain Mr. So-and-So, and when he leaves the service with a higher rank he is also plain Mr. So-and-So, giving no indication to the general public what his position may be. In fact, his rank is a bogus rank more than a real one, for he is excluded from receiving the full tokens of respect which are ordered for officers holding actual rank. While I was in conversation with a naval officer of high rank not long ago he actually did not know the difference between the different ranks in the engineer department. He did not know which was the higher rank—whether staff engineer or fleet engineer. If, then, a naval officer does not know the difference, how in the world are the general public to know. It is very different in the army, because to whatever department of

the army an officer may be attached, whether the Ordnance Service Corps, the Commissariat Corps or the Medical Service Corps he has titles which clearly indicate the rank he holds and there is no reason why an engineer officer should not have a similar distinction. I might go on to speak of the power to inflict punishment, but if once the military status is settled many other things will follow in natural course. I should also like to say a word or two on one proposal which has been advanced by opponents to the suggested reform of the status of the engineers of the Royal Navy, and that is that some of the executive officers should take up the study of engineering and take over the duties of the present engineer officers—who should be allowed to die out—and we see the beginning of such a scheme in the order referred to in the Addendum to the paper. Such an arrangement, like the amalgamation scheme, can only lead to the establishment of a body of imperfectly trained engineers, or amateur engineers if you like, who will naturally shun the most disagreeable and unpleasant part of the duties and leave that to the mechanic, warrant and petty officers. These men will soon find that the greater part of the onus and responsibility of maintaining the machinery in an efficient condition will devolve upon them, and then will begin to agitate for rank and status commensurate with their responsibilities. It is to be hoped, however, that the country will demand that the costly machinery of our ships of war shall be entrusted to the care of thoroughly competent engineers of the highest skill and attainments, who must be trained from their youth up and who must devote their lives to engineering. This is the only way to maintain our ships continually in the highest state of efficiency, and this is the condition of the Navy which the country

Mr. W. H. DUGDALE (Vice-President) said—I am sure every one of us who has listened to Mr. Morison's paper to-night must feel most indebted to him for the enormous amount of time and trouble which he has expended in producing this further contribution to such an important subject, and thereby enabling this Institution once more to express its views upon those matters which are of such vital importance to the efficiency of the Navy and the safety of the British Empire. The necessity for another discussion is undoubtedly accentuated by the extraordinary Admiralty Order contained in the Addendum to Mr. Morison's paper, and which, although it may form a basis for replies to unpleasant questions in the House of Commons, only proves to the engineering mind the utter inability of the Admiralty to realise the importance of the situation and the terrible risk we shall run if we do not promptly and emphatically raise our voices against the stubborn egotism of the present regime. We, who live in an engineering world and whose lives are devoted to the design and construction of the machinery, hulls and warlike equipment of warships, or of the fleets of merchant steamers which carry our flag into all parts of the world and upon whose regularity of transit our prosperity as a nation of traders and colonizers mainly depends, can fully realize the transcendent importance of this subject of naval engineering and its bearing upon the efficiency of the Navy. The history of engineering in the British Navy has been one of rapid development, a development which has resulted in the mammoth battleships and cruisers with whose construction and manipulation we are all familiar; and has given to the nation a fleet of fast auxiliaries in the shape of our famed Atlantic liners, a development which has made the existence of the fast torpedo boat possible, and which has brought advantages and blessings in its train that were undreamt of fifty or sixty years ago. Upon a previous occasion I pointed out how the evolution of a man of war during nearly 2,000 years had been gradual and tentative until the introduction of iron and steam, since which the development has proceeded by leaps and bounds. Until nearly the middle of last century there was nothing on board his ship the sailor could not do: the manipulation of his vessel was essentially an art, to-day it is most distinctly a science; a condition entirely due to engineering—and yet, as Mr. Morison most truly states, the naval officer of to-day either cannot or

will not differentiate between the engineer of to-day, with his innumerable duties and responsibilities, and the engine driver of fifty or sixty years ago. He cannot or will not put aside his fondly cherished feeling that he is the "Deus ex machina" who not only knows everything, but can do everything. We are quite prepared to admit that in the early days of the poor old engine-driver he (the executive officer) might, with a certain amount of training, have taken charge of the department had it not been beneath his dignity. But that state of affairs soon passed away. The evolution or development of engineering has been much too rapid and the performance of the duties which now devolve upon the engineer can only be accomplished by experienced men with scientific attainments, conversant with the principles involved in the various branches of engineering under their control, and it is to the engineer more than anyone that we must look to retain and safeguard the old and proud position of Britain's principal bulwark of defence. And yet the history of the naval engineer has always been one of indifference on the part of the responsible authorities at the Admiralty. It has frequently been a history of repression, and may have occasionally appeared to those who perhaps sympathize more warmly than others with the engineers in their unfortunate position, that it has also descended now and then to a history of persecution. As long as steam as an auxiliary either to the motive power of our warships, or as an aid to the manipulation of their weapons, remained in the inferior position it occupied for the first fifteen or twenty years after its introduction into the Navy, the matter might seem to be one that concerned the personal feelings of the naval engineers themselves rather than the public interests of the British nation. But the question has got far beyond the personal stage now, everything depends now in the British Navy upon the efficient performance of the naval engineers' duties, and upon the ability, zeal and determination which the engineer staffs bring to bear upon their important duties, and, therefore, any weak point either in the organization, administration or training of the engineer department of the Navy calls for immediate remedy. I have already stated that the adaptation of engineering science has increased by leaps and bounds during the last few years, and the author of to-night's paper has informed us of the enormous increase in the horse-power of the propelling machinery alone and the conse-

quent increase in the duties and responsibilities of the engineer staff during the same period. We are therefore in a position to gauge to a degree the disastrous effect which a policy of repression and a desire to depreciate the value of the engineer branch must have upon its members and upon the fighting power of our first line of defence. I mention propelling machinery only (although there are countless other machines on board a man-o'-war for which the engineers are responsible) because it is the intention of the Admiralty to relieve the naval engineer of certain duties with regard to the care and maintenance of hydraulic gun machinery and mountings and of the charge of dynamos, Whitehead torpedoes and their discharge tubes—I say nothing about the wisdom of such a step, it may be an advantage, but a captain of a merchant vessel would hardly allow an officer to repair his chronometer because he is in the habit of winding it up. The suggestion is too stupid to waste time in considering, though it would be somewhat entertaining to see the torpedo lieutenant taking to pieces and repairing the delicate mechanism of a Whitehead torpedo. The author of the paper has pointed out the dangers of entrusting the care of machines to imperfectly trained mechanical officers—and he has drawn attention to the probable friction and certain disasters that are likely to result, and to the inconveniences that are likely to arise from the multiplication of separate mechanical departments in a warship. The present step, whereby gunnery and torpedo lieutenants are to take charge of machines, is another indication of the determination of the Lords of the Admiralty to repress the engineer and minimize his importance. It would be of interest to know whether the responsible engineer officials at the Admiralty were consulted about this change or whether they advised it. Personally I am of opinion that the head of the engineering profession at the Admiralty could never have been consulted on this matter, but that their Lordships have with their usual innate egotism ignored him and have referred the consideration of the ways and means to carry out their desires, to a small body consisting of the captains of the "Excellent" and "Vernon," and the Chief Inspector of Machinery of the Portsmouth Reserve. The two former officers are naturally advocates of any scheme which will enhance their own importance, and the latter is the subordinate professionally of the engineering head of the Navy. In any

case, if it is necessary for all the working officers of the British Navy to be engineers (and I believe that the formation of a separate engineer corps would be the most efficient step), why cannot the Admiralty have the courage of their opinions and amalgamate the two branches and so have eventually only one class of officer in the Navy, who must be perfectly trained in engineering as well as other duties? If the proposed alteration is an attempt to cut away the pretensions of the engineer to better treatment and to prevent engineering from attaining that position which is necessary in the true interests of the Navy, and which is as sure to come as it is certain that the sun will rise to-morrow, such an attempt will recoil upon the heads of the class of officers who are responsible for its introduction. But it will have a worse effect than this, it will strike a blow at the efficiency of the Navy in which we, as engineers, are vitally interested, and which we, of all other professions, are better able to appreciate and desire. Now the point I wish to make in this matter is this—It does not matter one jot, so far as the importance of the object of Mr. Morison's paper is concerned, whether such a small portion of the engineers' duties are transferred to other officers or not. The engineers' importance to the Navy will still remain virtually as great: but I consider the Lords of the Admiralty, by their sudden determination to transfer certain duties to officers of their own branch, shew that they do not realise the importance of the subject under consideration. Ever since the introduction of torpedoes, dynamos, and heavy guns worked either by hydraulic or by steam power, the engineer staffs of the various ships of H.M. Navy have kept these things in a high state of efficiency notwithstanding the disadvantages they have from time to time

But it is absolutely the fault of the official regime and this is the way in which the Admiralty are now endeavouring to screen their delinquencies in a matter which has extended over a period of many years, and are trying to cover their retreat because public opinion is becoming too strong. It is difficult to understand the spirit of cheerful optimism, amounting almost to levity, with which the Admiralty always appear to treat such an important matter. We have already seen what this kind of thing has led to in our experience in South Africa, and I have no hesitation in saying that this indifference—or worse—of the Admiralty towards engineering matters is just as likely to lead the nation into serious difficulty, if not disaster, should the Navy unfortunately be put to the same strain that the Army has been lately subjected to. The weakest link at present in the chain of naval defence is the unsatisfactory condition of the engineer branch. I cannot believe that the Lords Commissioners of the Admiralty are relieving the engineer officers of the duties I have previously mentioned with any hope of increasing the efficiency of the Navy. It seems to me it is another attempt to keep the engineers in the background, not perhaps from any antagonism to the profession, but purely and simply to still further postpone, if possible, the re-organization of that branch, the necessity for which has now become acute. But after all the reason is not far to seek. The old-style naval officer of whom we have been so justly proud, with his glorious and historic traditions, is an almost extinct species; the stern necessity for his existence is rapidly becoming a thing of the past. He undoubtedly recognizes this fact and is therefore determined to do all in his power to discourage the new naval officer whose profession makes him so necessary for the efficiency of the Navy. Without whom in fact henceforth, the Navy cannot be! And apropos of the question of naval efficiency, we cannot do better than carefully consider the remarks upon the subject by Admiral Melville, the engineer-in-chief of the United States Navy, because his views are based upon actual war experience. We must remember that we have had no naval war experience since the introduction of steam, whereas the United States Navy not only had the trying ordeal of their civil war, but their more recent experience against the Spanish fleet, and if anything can serve as an object lesson as to the advantages of engineering efficiency over inefficiency under conditions which were otherwise

essentially equal, we have only to remember the engagement at Santiago and the chase of the swift cruiser "Cristobal Colon" by the slower battleship "Oregon." The melancholy results of the opposition to the well-being and efficiency of the Navy by the executive branch has been most eloquently told by Mr. Morison to-night and in the most impressive manner by the diagrams before us. Having taken up so much of your time I will only refer to two, viz., that shewing the relative increase in horse-power and the decrease in applications per vacancy at the Royal Naval Engineers' College at Keyham, and that showing the decline in candidates for temporary service assistant engineers which by January, 1902, has fallen to zero. What an admission to make to the universe, viz., that we who pride ourselves in our engineering progress and attainments have actually by arrogant and egotistical opposition succeeded in making one of our most honourable and important professions the most unpopular. But it is no use attempting it any longer, we might as well try to stem the flowing tide with the proverbial pitchfork, and if the necessary reform cannot be gracefully accomplished at Whitehall it behoves us to bring such pressure to bear as may be necessary to enforce our just demands. We cannot afford to sacrifice the prestige of our Navy and the safety and dignity of our Empire although this is surely what will happen unless the errors to which we draw attention are promptly rectified. One of the most important of our demands is that the engineer, being responsible for the efficient working and maintenance of practically all the material, should have military rank and control over his department. You will at once realise that it is absolutely impossible to maintain the necessary discipline and morale of a department if the

portions of auxiliary machinery connected with respective duties. For instance, the gunnery lieutenant has the hydraulic fittings connected with the guns and hydraulically worked machines connected therewith. But he has nothing to do with the hydraulic pumping machinery. The torpedo lieutenant has electric motors, electric lighting, torpedoes and discharges, but he doesn't generate the electricity nor yet take the responsibility of the air-compressing machinery. In fact, the engineer is responsible for the production of all the motive power. It is a matter for deep disappointment that no answer has yet been vouchsafed to the representatives of the combined parliamentry and engineering deputations which waited upon the first Lord of the Admiralty last July, but the members of the engineering profession will, I think, feel assured that the step which was taken then by the engineering institutions will be followed up until the present blot on the engineering administration of the Navy is effectually removed. I am sure that engineers of all shades of opinion and everybody in the country who takes the slightest interest in the Navy must be convinced of the absolute necessity of the reforms in the engineer branch so ably advocated in the paper we have heard read this evening.

Professor R. L. Weighton, M.A. (Vice-President) said—I congratulate Mr. Morison on this the second paper he has presented to the Institution on a subject of most pressing national importance. I am perfectly certain that all who have carefully read it will agree that the several points are well and tersely put, in language which could not be improved upon. The present paper adduces many new facts in support of the contentions of the first paper. To my mind the opinions expressed and the statements made in the Memorandum submitted by the deputation to the First Lord of the Admiralty in July last are amply justified, and proved in accordance with all the accepted laws of evidence. As the unsatisfactory nature of the reply of Lord Selborne to the deputation is the reason for the present paper, one naturally turns to the terms of that reply as the centre of interest. On page 153 of the paper, Appendix C, the gist of the reply will be found.

In spite of all that has been already adduced, Lord Selborne states in language which admits of no ambiguity that he still holds:—

(1) That the engineer branch of the Royal Navy adequately performs its functions.
(2) That there is no want of discipline in the engine-room or stokehold.
(3) That the department is not undermanned.
(4) That the Admiralty get the numbers they ask for, and they get them according to their own standard.
(5) That it is not advisable to alter the constitution of the Board of Admiralty, so as to include the engineer element.

These five points enbrace the principal questions raised in the Memorandum, and upon them the First Lord expresses himself clearly at variance with the Memorandum and the deputation. He said, and rightly so, that some of them dealt with matters of opinion. But with regard to others he used the words "misrepresentation." It is to be presumed he meant unintentional misrepresentation. But if this was the kind of misrepresentation to which he referred, why were these misrepresentations not corrected by some kind of evidence? In all cases, evidence in detail was adduced in the paper on which the statements in the Memorandum were based.

All the points except No. 4 may in a sense be considered as being largely matters of opinion. No. 4, however, deals with a pure matter of fact, and ought, therefore, to be susceptible of proof by evidence readily accessible to the Admiralty. The First Lord says—I assume he is correctly reported—"We get those we ask for according to our standard." If this is so, then the standard must be a standard of failure. In this matter it so happens that I can speak from personal knowledge. I believe I can bring for-

may here say, that in this part of the country we have usually had several students each year qualifying at the local College for sitting the examinations for direct entry into the engineer branch of the Navy, but for some years back the numbers have been dwindling, and during the present year there are none at all. So much for the assertion that they get applicants up to their standard. But there is another point here calling for explanation. The standard itself has been admittedly lowered of recent years. Why has it been lowered? I don't suppose it was lowered in the interests of the candidates. The whole tendency of modern education is to raise standards in all professions. It has recently been distinctly raised in medicine, and in the Universities and Colleges with which I am acquainted it is almost continually being raised for Degrees or Certificates in the engineering faculties. In the case of the Admiralty it could only have been lowered because of the difficulty experienced in filling vacancies in the ranks of the engineers. Why does not the Admiralty frankly and openly admit this, instead of attempting to obscure the issue by asserting that they get the numbers they ask for, and that they get them up to their standard? Reverting to the questions which may be considered as involving, more or less, matters of opinion—viz., Nos. 1, 2, 3 and 5—it is obvious that if the department is undermanned it cannot possibly adequately perform its functions, to that Nos. 1 and 3 may fitly be considered together. The Admiralty—through the First Lord—does not admit undermanning. Outside expert opinion in the engineering profession of the country holds that there *is* undermanning in the engineer branch. Which is the better judge in this matter? Had the present Board of Admiralty been thoroughly up-to-date, and thoroughly representative of the Navy of the present day, there would have been very good reasons for allowing that the Admiralty was the better judge. But, even on the First Lord's own shewing, the Board of Admiralty does not pretend to be in the least of a representative character. It is utterly destitute of that element which is the pre-eminent characteristic of a modern Navy—the mechanical element. Whereas the engineering mind of the country is undoubtedly an excellent authority on this subject, seeing that it includes the very men who not only design and build almost the whole of the propelling and other machinery of His Majesty's ships, but who also run that machinery under most exacting con-

ditions of trial. In this connection one wonders if the members of the Admiralty Board ever get the opinions of their own engineer officers afloat? If they did get those opinions they would hear some very definite views not at all agreeing with any of those enunciated by the First Lord. With regard to Lord Selborne's denial of any lack of discipline in the engine-room and stokehold, of course, as Mr. Morison points out in the paper before us, the discipline referred to was obviously not mere blind unreasoning obedience to orders. It is that higher kind of discipline which may be expected to result from organized training under a supreme directing mind, and under which bodies of men instinctively continue to discharge their accustomed duties efficiently in times of great excitement and probably of great danger. Such discipline as this one would suppose would be most essential beneath the protective deck during the excitement and stress of operations in naval warfare. And here the Admiralty do not seem to realise the facts of human nature. Every manager of men, every foreman or superintendent, knows that unless he has the power of rewarding or punishing those under him—in industrial works by increase or diminution of pay, or by discharging or promoting men, and so on—he cannot hope to have that kind of control over them which is vital to successful work. This is an elementary principle which the merest tyro very quickly appreciates when he first obtains the management of men. The British naval engineer has not got this power over his men, and until it is given him in some adequate shape or form, he will never have such an influence over those under his orders, as to secure from them the highest and best work in emergencies, not to mention ordinary conditions. The case brought forward by Admiral Melville is in this connection a most instructive one. The rated 16-knot "Oregon" overtook

machinery, *i.e.*, less weight of machinery, thus making it possible for her to either steam faster or to carry more armour or armament. It is of course a truism that the power-value of a ship depends not upon her rated power but upon the actual power her staff manage to develop in her. But it is a truism which in this connection would seem to be worth more attention than it usually gets. For, the ship with the powerful machinery and the defective staff is worse off than the ship with machinery of less power but which is worked up to its utmost by a competent staff. We now come to the last expression of opinion on the part of the First Lord—that relating to the constitution of the Admiralty Board itself. The description of the Board given by the First Lord is so interesting that I will quote his own words:—"The Board has not been and never will be a collection of the Heads of Departments, but consists of the Lord High Admiral, or a number of gentlemen selected by the Crown. The Lord High Admiral you might compare to the Secretary of State for War and the Commander-in-Chief rolled into one; those are his functions and what the Board of Admiralty has always been. When it has not been the Lord High Admiral, it has been a number of gentlemen selected by the Crown who hold that particular office under commission. It is open to the Crown to change members of the Board, and to elect members on the Board. The Comptroller for instance, has been on and off, and when he is on he may be off again. A civil engineer has been placed on the Board at one time, but he is not there now. I merely point to that to show you that it is a misrepresentation to state or to assume that the Board of Admiralty is a collection of Heads of Departments. It is no more that than the Secretary of State for War and the Commander-in-Chief themselves represent the Heads of Departments. . . . Of course, it may be a matter of opinion as to whether or not there should be a collection of Heads of Departments, but that is another point with which, however, I do not agree. The point I want to put forward is that to have a collection of Heads of Departments would be to have a complete reversal of the whole of the history of the Admiralty and of its origin." Passing without further comment the extraordinary description here given of the various possible, and seemingly hap-hazard forms which the Board may assume, and which description is reminiscent of Gilbert and Sullivan and H.M.S. Pinafore, one naturally asks whence comes the authority for any

one individual to lay down the dictum as to what "never will be?" Further on the War Office is referred to as an analogy. Surely this is a most unfortunate comparison at the present juncture. Must the country wait for a naval Boer war to reveal the shortcomings of the Board of Admiralty?

We are told the Board is not a collection of Heads of Departments. It is certainly not a collection of the Heads of *all* Departments, but according to its composition at the present moment, it is to all intents and purposes, a collection of the Heads of *one* Department, which department goes by the title of the Executive Department of the Navy. Its present-day constitution is virtually a survival of the days of the wooden walls, when there was *one* department, and one only, in the Fleet. Now there are several departments, and which is the most indispensable it would be impossible to say. All are essential, and if experts in one branch are to have a voice in the supreme management and control, then experts in other important branches ought, in the interests of efficiency, also to have a voice commensurate with their importance. I am strongly inclined to believe that until the present constitution of the Admiralty Board is altered, the evils complained of in the fleet will never be thoroughly eradicated. The source of the disease is the Admiralty Board, and unless the source is attacked, the cure can only at best, be temporary. It is not reasonable to expect that a body of experts in one branch can do full justice to other branches, with the abstruse technicalities of which they cannot be expected to be acquainted, and with which, as experts, they are out of sympathy. To attempt to manage a highly specialized and technical organization like the Royal Navy, including as it does within itself representatives of several different professions, by means of a Board composed of experts in one

would stand an equal chance of receiving that consideration and position to which its importance would entitle it. Under a Board as at present constituted, it is hopeless to expect such impartiality and justice. The more one ponders this subject, and the closer one examines it, the more firmly does one become convinced that the Admiralty has, so far, failed to fully realize the essential character of the machines they administer. A modern warship is a floating box of machinery. It is the greatest and most awe-inspiring aggregation of power in one unit, yet devised by man. On its operation on the day of stress may depend the security and even the very existence of the Empire. Naval tactics are necessarily of the utmost importance—they are indeed of primary importance—but futile indeed will be the most brilliant tactics, if the floating mechanism fail in the hour of trial. To minimise the risk of such failure, it surely behoves the Admiralty to adopt all possible precautions. They have at their service the highest marine engineering talent the country can produce, if they like to enlist it. They require this talent, and they require abundance of it, not only afloat, but at headquarters ashore. In concluding, I would venture to summarize by giving three reasons for reform in the directions indicated:—

(1) The discontent which exists amongst the engineer officers of the fleet.
(2) The practically unanimous opinion obtaining amongst the marine engineers of the country.
(3) The chronic state of inefficiency of the machinery of a large proportion of His Majesty's ships.

The first and second are facts which are ominous, and the existence of which ought surely to cause grave searchings of heart at the Admiralty. As regards the third, I contend the truth of it can be proved by evidence which will satisfy any impartial mind, and we suggest it is due largely and chiefly to undermanning and want of executive authority in the engineer branch, and to the inadequate, antiquated and abortive constitution of the Admiralty Board itself.

Mr. D. A. Bremner said—In view of the lateness of the hour I will endeavour to be brief, and therefore, if I do not lay much stress upon the privilege which I have in addressing this meeting,

nor refer in terms of praise to Mr. Morison's paper, I trust you will accept my assurance that it is not due to any lack of appreciation but simply to a desire to economise your time and patience.

I take it that the object of contributors to the discussion should be to reveal new facets of the subject, or to shed new light upon facets which have been previously exposed, rather than to merely reiterate the author's statements.

Mr. Morison's papers carry exceptional weight and conviction, by virtue of the fact that they are not a mere string of critical generalisations and pious opinions, but present a formidable array of definite statements of fact, and reasonable deductions therefrom in support of his allegations, and embody specific recommendations constituting a complete scheme of reconstructive reform.

Such an array of facts and specific recommendations should afford tempting tilting for the champions of an outraged Admiralty. The case for the engineers has been so completely disclosed and substantiated by a recital of material facts, and has been so fully endorsed by a large and representative body of expert engineering opinion, that it will scarcely suffice for the Admiralty to resort to the usual official tactics of mystical silence and aloofness. They must either refute the alleged facts or else stand convicted of a grave dereliction of duty. The existing condition of the engineer branch is not accidental and peculiar to His Majesty's Navy; it is typical of the state of affairs which either has existed or now exists in the principal navies of the world, and is simply a stage in an evolutionary process. I do not think we need bother our minds very much about many of the minor disabilities and discomforts to which engineer officers are subjected;

The Admiralty, and the conservative section of the executive branch, cannot prevent the ultimate completion of the evolutionary process, but they may retard it, and by so doing, postpone the realisation of maximum efficiency.

The nation, however, cannot afford the risk and waste of time and money attending such retarded progress towards efficiency, and the internal artificial forces retarding the natural course of evolution must be neutralised by equal and opposite external forces. I suggest that the creation and effective application of such forces is the work which lies before the marine engineering Institutions in connection with this important question.

It is, to say the least, disquieting to find that external pressure should be required to induce the Admiralty to act in accordance with the dictates of reason.

Changes in organisation and method, to meet the requirements of changed conditions, should emanate from within, and be inspired by an intelligent honest desire to attain the highest possible naval efficiency.

The attitude of King Canute towards the rising tide was sane, as compared with the attitude of the Admiralty towards the growing importance of engineering in relation to sea power. King Canute's risk was limited and personal, whereas the risk undertaken by the Admiralty is unlimited and may involve the whole empire in irretrievable disaster.

When subjecting the executive branch to criticism, it is only fair to admit that there are many executive officers, in the Navy to-day, who are sufficiently enlightened and liberal-minded to frankly recognise the true position, and support the suggested reforms in the engineer branch of the service.

With a few notable exceptions, the progressive spirit is unfortunately restricted to the younger executive officers, who are not in a position to influence the action of the Admiralty. Certain admirals after retiring from the Board have been seized with an attack of virtue, and have given unmistakable expression to the opinion that the demands of the engineer officers are perfectly reasonable, but what we require is that the admirals who are in power on the Board at the present time should find salvation. Those are the men who alone can institute measures of reform. The explosions of virtue which sometimes take place when the restrictions of active service are removed, afford some

indication of the strength of the written and unwritten laws which tend in the Navy, even in defiance of reason and experience, to always maintain the *status quo*.

It is easy to advance theories, as to the organisation and training of personnel best suited to fulfil the requirements of modern steam navies. It must be remembered, however, that, with a huge navy already in existence, it is impossible to start *de novo*, and it may be quite impracticable to carry into execution, a scheme which may be indisputably correct from a theoretical standpoint.

Any practical scheme for reform must, even in its earliest stages, preserve at least the existing degree of efficiency and preparedness for war.

The transition from existing to higher efficiency must be continuous, even though slow. Any intermediate retrogressive stage is impermissible.

The great merit of the scheme of reform submitted by Mr. Morison, and endorsed by the marine engineering institutions, lies in its moderation, and in the fact that it fulfils the practical requirements to which I have just referred. Whilst on this subject, I would state that, whatever may be the limitations imposed by practical considerations upon immediate reforms, I have no doubt that, at some future time, our naval personnel will be much more fluid and adaptable than at present. I do not believe it possible to perpetuate a system of organisation which might result in a ship having to strike her flag, owing to disablement of guns' crews, whilst one-half, or more, of her total complement still remained injured and full of fight. To some extent the principle of adaptability has been recognised in the military

engine-room. It would seem only reasonable, to so train the men that surplus in any department would be available to fill up depleted ranks in any other department of the ship.

When considering the question which is now under discussion, it is helpful to one's sense of proportion to remember that there are under one thousand engineer officers of all ranks in His Majesty's Navy, and that their total annual cost is only about £282,000. The number of officers and the annual cost are, therefore, so trifling, as compared with the vastness of our naval organisation as a whole, the £30,000,000 which we expend annually upon it, and the magnitude of the interests under its protection, that in view of the great influence exerted by engineer officers upon the fighting value of the fleet, it would appear to be absolute folly to neglect any effort to insure that their numbers shall be adequate and their quality the highest that the country can produce.

It has been shown that the granting of executive rank to the engineer officers is the fundamental necessity in any practical scheme of reform, and it is upon this point that the fiercest opposition has been centred.

I do not propose to take up your time by entering upon any lengthy arguments and explanations relating to this question, but it may be suggestive to draw your attention to the following relationships:—

Rank, authority, discipline.

Discipline, efficiency.

Rank, honours, sentiment, *esprit de corps.*

Sentiment, *esprit de corps*, fighting efficiency.

Rank, honours, number and quality of candidates.

Number and quality of candidates, efficient operation of selective process, high standard of officers entered.

High standard of officers, efficiency.

The disastrous effects of the short-sighted policy of the Admiralty in the past, upon the number and quality of candidates for appointments as engineer officers in His Majesty's Navy, are clearly revealed in the excellent diagrams which accompany Mr. Morison's paper. We could have no better illustration of the inevitable Nemesis which follows any violation of the laws of good sound common sense.

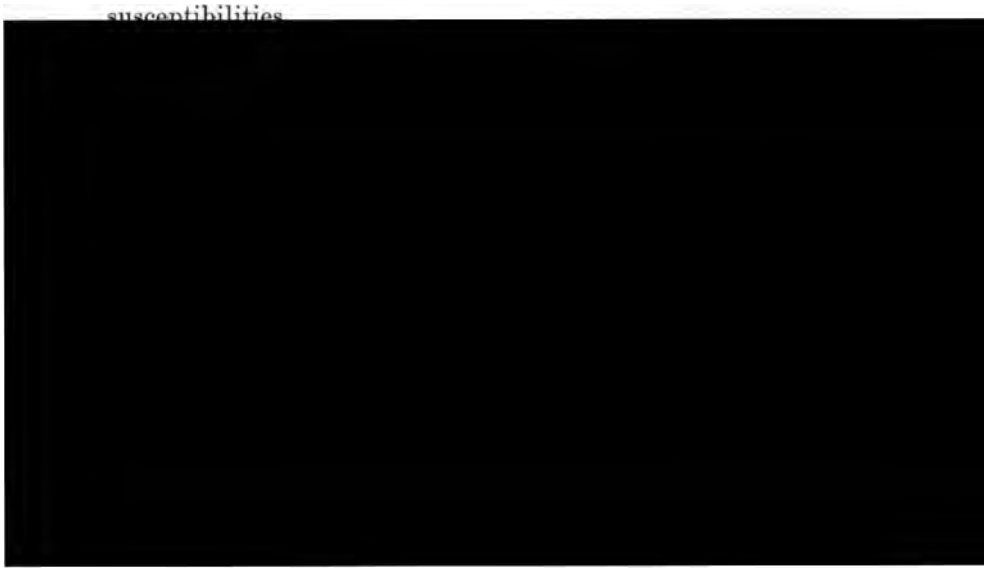
Judging from the ambiguity of its wording, the new Admiralty Order would appear to have been issued in haste, and I venture the opinion that it will be repented at leisure, as, in direct viola- of all engineering experiences, it delegates engineering duties to executive officers, the senior of whom are too old to learn engineering and the younger of whom cannot possibly become competent engineers in less than ten years.

Responsible ministers and officials of our great departments of State seem to expect the blind confidence of the public, without making the efforts necessary to deserve it.

The age of fetish worship has passed however; we have become accustomed to the shattering of idols, and few of us have many remaining delusions as to the association of high ability with high position. We can only admit the association when convincing evidence of its existence has been forthcoming. Gallant admirals, who are at present blocking the road to progress, would no doubt die patriotically enough for their country, but human nature is complex, and experience shows that so amiable a virtue may be allied with other and less admirable qualities. We do not, however, wish aged and gallant admirals to die for their country.

We wish them, in the interests of naval efficiency, to pass into honourable retirement, and live in enjoyment of the honours and rewards, which a rightly grateful country has bestowed upon them in recognition of valuable services rendered to the country when they were in their prime, and were, by training and habit, more in harmony with the requirements of the age.

We dare not permit our supremacy as a sea power to be destroyed through deference to hoary traditions and personal susceptibilities.



to throw fresh light on a subject he has made so completely his own, or to add to the magnificent series of papers he has read to this Institution, will find his task difficult indeed, if not impossible. It would certainly be impossible to state one's views with more force or clearness than Mr. Morison has done, and one almost fears that in the attempt to say anything at all he will be guilty of mere iteration. We can all do one thing, however, and and that is to express our entire sympathy with the cause which Mr. Morison has so ably taken up, and to record in our minutes of proceedings our dissatisfaction and indignation at the determined attitude of what we must call an effete Admiralty Board towards a staff which deserves the best encouragement and consideration they can have extended to them. I have not previously taken any part in the discussion on Mr. Morison's paper, not because I am not alive to the magnitude of the question that it involves, but because I felt I did not know the subject fully enough to be able to speak with any degree of confidence upon it. I also know there are members of the Institution more able than I am to take up the cudgels in support of the paper and wield them to better purpose. But believing as I do that the questions involved are of national importance, and that a mere passive acceptance of information put before us does not tend to the forwarding of the matter in hand, I have recently, on my own behalf, and for my own satisfaction, made some private investigations in the matter, and I can confidently say this: that the picture Mr. Morison has put before us of the state of affairs in His Majesty's Navy, especially of the branch of it concerning the engineers, is in every respect a perfectly true picture. He has given us a clear and true statement of the whole case, his communications have formed neither more nor less than a statement of the truth, the whole truth, and nothing but the truth. He has said that the question is of national importance. I should say that it must become of the intensest interest to every member of the community. If the occasion should ever arise when the British Navy should be put to its ultimate use, Great Britain would depend, for her very existence, upon the strength and efficiency of the Navy, and her position as a first power amongst the nations of the world would depend, primarily, upon what her Navy could do, and I believe there is no more potent factor making for the general peace of the world at the present time than the

manifestly pre-eminent strength of the British Navy. If this is so, and if it be a fact, as is alleged by our most severe critics—even those critics who are most malignantly critical—that we possess the most magnificent *materiel* that the skill of any country can produce, is it not almost maddening to find that throughout the Navy its *personnel* is not composed of members that the highest breeding and training can produce? And why? Simply because we have a Board of Administration that will continue an attitude of *laissez faire* and will not recognize that things as they are are not coincident with things as they ought to be. It is a fact that the administration of the Admiralty is to-day not essentially different from what it was half a century ago.

Opinions in favour of the assimilation of the executive and engineering branches of the Navy are growing, and we have had examples of it in the United States Government. I believe there they have carried the idea too far, and it has so far proved unsuccessful. We have, however, Admiral De Beaumont, one of the most distinguished officers in the French service, advocating such a policy. He has not a high opinion of his engineer officers, because he is advising the so-called executive officers to learn engineering. I think these branches of service sufficiently different and distinct to allow of their being treated as distinct services. Jack-of-all-trades makes master of none, and I have no doubt this simple homily will apply in the ranks of the Admiralty, as truthfully as in the humbler walks of life, and those who would have executive officers learn engineering as well as navigation and tactics talk in ignorance of the requirements of the engine-room. We have recently had sufficient evidence of the capabilities of deck officers to look after severely technical details. It will still be fresh in the minds of many the terrible bungling that

being trained and fired, however, the executive officer is in absolute charge and the poor engineer ranks simply as a convenient mechanic, and is treated as such. So much so is this the case, and so great is the risk of being snubbed for interfering that in the present instance the engineer, although present at the time of the catastrophe, dared not offer his assistance. What he did do was to grasp at once the situation and acting promptly in his own particular sphere prevented the flooding from spreading to the other compartments of the vessel.

The interchange of officers between the bridge and the starting platform would be disastrous to general efficiency, as has been proved in the American navy; and the proposed transfer, in our Navy, of the supervision and repair of the machinery associated with guns, shot hoists, torpedo-firing machinery, air-compressors and such to gunnery lieutenants, will be disastrous both to the efficient upkeep of these details in themselves as well as to their ultimate use. No matter how attractive the idea is of engineers having the privilege of doing a little navigation and of bridge officers undertaking a little engine-driving neither can possibly be done well.

I can only add my note of congratulation to Mr. Morison upon the magnificent series of papers he has put before this and other institutions, and express the hope that, in the near future, these wrongs that are being suffered by our brethren in the Navy may be righted.

Mr. T. WESTGARTH (Vice-President) said—I consider that the Admiralty have long ago given away their case and admitted ours, but unfortunately have not the courage of their convictions. I refer to the fact that they gave the engineer officers in the Navy relative rank, but have not been able to make up their minds to make that rank actual. The executive officers profess to believe that the engineers have no grievance and the matter is of no importance, but suppose it were suggested that the titles of executive officers, which are really military titles, were done away with, and captains called masters and commanders and lieutenants masters' mates, what objections would be at once raised. After much consideration it was found necessary and advisable to carry out the arrangement in the army which we wish for in the navy, so that now in the army an officer has the same title and rank what-

ever branch he belongs to, even including the medical corps, and as it happens the engineer branch in the army is considered the senior, surely, therefore, reasoning by analogy, the engineers in the navy should have a position equal to any other branch of the service and should have the same titles. We also claim that the engineer officers should have the same emoluments and recognitions as other branches of the service. During the present war bushels of medals and no end of titles have been conferred, many of these upon naval officers who have taken part, but how many have been given to the engineer officers?

A MEMBER—None at all.

Mr. WESTGARTH—Take a case in point, viz., H.M.S. "Ophir," referred to in the paper. The captain was promoted to commodore and granted two honours, viz., C.B. and M.V.O.; the commander was promoted to captain and made an equerry to the Prince of Wales, the first lieutenant was promoted to commander, two sub-lieutenants to be lieutenants, the surgeon to be staff-surgeon, and the assistant paymaster to be paymaster. The naval engineer on board was promised that some day he might receive an award, which by the time it came would probably be his due for length of service. However, there is one consolation that in the long run the public must and do get what they make up their minds to have. It is sometimes troublesome and difficult to carry a necessary reform, and pitiable that it should be so, therefore I say more honour to Mr. Morison for the fight which he is leading, but if we agitate and shew the Admiralty that we are determined to have a fair measure of reform undoubtedly we shall get it. There is no need for me to try and convince you, a body

branch say that this is a small matter but that is not so. What would a major of infantry say if he had to appear before an artillery captain to punish or reward his men? and yet something very like this takes place in the Navy, where an engineer officer may have to take a man on deck before an executive officer, junior to him in rank and possibly many years in age. I think we should protest against the insinuation thrown out by the First Lord of the Admiralty when he met our recent deputation and suggested by questions that the discipline and loyalty of the engineer officers might not be all that it should be; was ever such a cruel thing said? The men who for twenty years have carried on the duties of our ships and year after year have had piled on their shoulders more complex and arduous duties and yet have loyally and properly carried on their work notwithstanding their unsatisfactory position certainly deserve great credit and must be most loyal officers. It is no wonder that candidates cannot be found who will enter the Navy as engineers under the present state of things; I am very frequently consulted as to the career of young engineers, unfortunately it was impossible that I should recommend them to join the Navy. This ought not to be so, and if the conditions were reasonable, what a splendid opening there would be for great numbers of young engineers in the country. It is often stated that the naval engineers' wishes are only a matter of sentiment; well, suppose it is sentiment, where is the relation in life where sentiment does not come in? What is it that holds men to their duty, and what will keep the engineers below in time of action, when possibly the engine and boiler-rooms may be like an infernal region? Sentiment!

The PRESIDENT said: I am sorry the time for discussion is all gone, and there are only about two minutes left for me to point out a few facts. To put the result of this meeting into a concrete form it is proposed to send to the Admiralty a new Memorandum. The Memorandum which is printed in the *Transactions*, page 139, was presented to the Admiralty and a deputation waited upon them and spoke upon it. The present proposed Memorandum is only slightly altered from that, but it is improved, so we think, and this Memorandum will be placed before the next meeting of the Council. After the Memorandum is approved by the Council and has been sent to the various institutions it will come before

the next general meeting of the Institution which will be held at West Hartlepool on Saturday, the 22nd February, at which meeting Mr. Morison hopes to be able to present his reply to the discussion. I hope then the Memorandum will be confirmed, and that at the same time we shall have the consent of the other institutions, so that it may be sent to the Admiralty without delay. I think it only remains for me now to present the thanks of this meeting and of the Institution to Mr. Morison for his very able paper. I am quite sure that the feeling on the part of the members of the value of this paper is very sincere indeed. There is only one word I would say on the discussion. I do not think it is quite right to take the remarks made by the First Lord to the deputation as being a reply to the Memorandum. He told us in the first place that he did not intend to make a speech. These remarks were not a prepared reply to the Memorandum, and I say we have had no reply. We want a reply, and we expect some sort of reply, and, we hope, a satisfactory one to the revised Memorandum.

The meeting then concluded.

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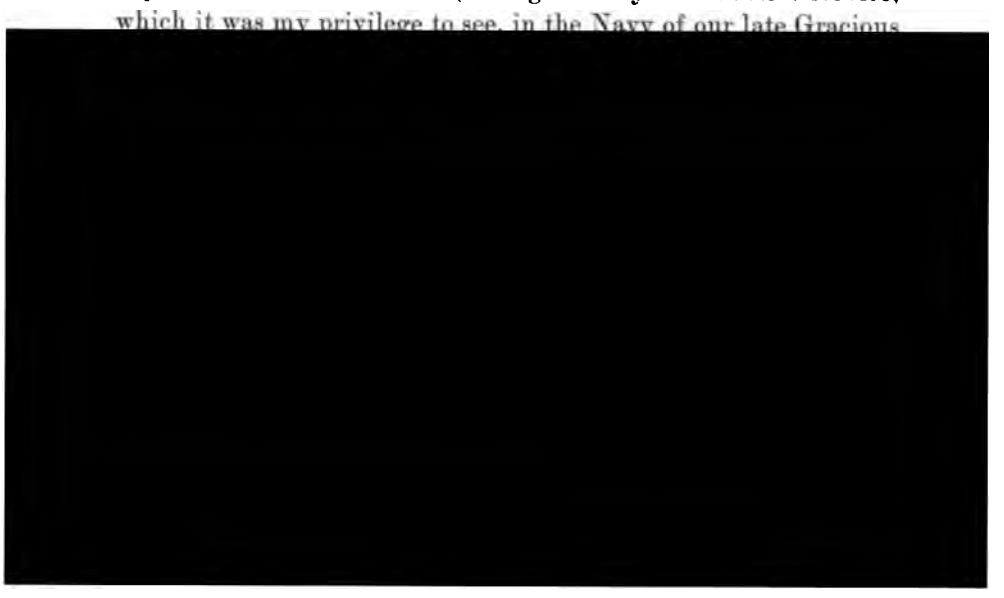
The following communications have been received by the Secretary:—

*February 6th*, 1902.

DEAR MR. DUCKITT,

By the courtesy of the executive of your influential Institution, I have been invited to lay before your members the results of my experiences and observation (during the 37 years of active service, which it was my privilege to see, in the Navy of our late Gracious



This question is one deeply affecting the whole British Empire. It is not a question of what the engineers of the Navy want. It is not a question of professional etiquette, or of class legislation, but it resolves itself into the far more important one—"How does it affect our Navy?" My answer to that question is this, that "the efficiency of our Navy is so intimately entwined and bound up in the question we are considering, that the safety of this nation may be secured or forfeited by the action which the authorities may or may not take on your initiative." For years the Admiralty have been advised and entreated to deal with the engineering question in a broad, liberal and impartial spirit. To lift it above class prejudices and the traditions of a Navy dating back to the days of Nelson. The proof—if proof were wanting—that they cannot emancipate themselves from these traditions, from the cherished belief that the British Navy belongs by right to the successors of Nelson, and that no others may aspire to any military or naval command or control therein, is to be found in the latest order emanating from the Admiralty, directing three officers to form a committee to draw up a scheme, whereby torpedo and gunnery lieutenants may be put through a course of practical instruction, which will fit them to take charge of all machinery outside the engine-room. We do not need to beat about the bush, in the endeavour to find a reason for such an extraordinary fiat, it lies upon the surface, where he who runs may read. It is this: the authorities can no longer shut their eyes to the fact, that the complements of engineer officers, artificers, and stokers allowed to our ships of war, are utterly inadequate to deal with the multifarious duties which fall to their lot. They are continually being told that defects are increasing; that our ships cannot do what they ought to do as regards speed, because the engine-room staff is too small for the work it has to perform; that our ships have to spend more time in harbour, and in dockyard hands, making good defects which would have no existence were the complements adequate to the work devolving upon them. You will say to me, "But why not increase the engineer staff?" Ah! that is a question I put to myself many years ago, but the answer was long in coming. When it did come, it staggered me. The command or control of men means power and authority. Fifty years ago the engine-room staff of a big battleship was probably not more than from three to seven per cent. of the ship's company; to-day, if our

engine-rooms were adequately manned, the proportion would probably be nearer fifty per cent. Now if the chief engineer of a big ship had as many men under his control as the executive officer, don't you see that by every sense of right and justice the engineer should stand at least on an equality with the executive officer. But the control of an equal number of men is not the sole claim of the engineer to equality with the executive officer, for the engineer can appeal to the greatly enhanced importance of the duties and responsibilities resting upon his shoulders, in comparison with which those of the executive officer cannot be weighed or measured, so great is the disparity. Something had to be done. Either the engine-room staff had to be augmented and brought up to the point of efficiency, or the engineer must be relieved of some of his duties, etc. Which is it to be? I almost fancy I can overhear the confidential chat between the First Lord and his Naval colleagues. What is to be done?" says Lord Selborne, "you acknowledge that the duties of the engineer department are beyond the powers of the existing staff to cope with. Can we not increase their numbers? I confess that seems to me to be the simplest way out of the difficulty." That is what we should all probably suggest as a practical, commonsense way of getting over the difficulty, because, mind you, there is no question of the engineer's ability to carry out all his exceedingly important duties, if only a sufficient, and thoroughly efficient staff were allotted to his department. In the whole course of my service I never heard that question raised. It has always hinged upon the difficulty of finding accommodation for the added numbers. Well, this new order shows that the commonsense solution was not approved. It was much too plain and straightforward a way out of the difficulty. And so we see that the "dilettante" engineers of the

ery outside the engine-room. Most of, if not all, those torpedo lieutenants are now serving in the higher ranks of captain or admiral, and some of them are to be found in offices in the Admiralty itself. Is it any wonder then, that the policy of 1877 is being introduced? The first step in this direction was taken about a year ago, when it was decided to enter one hundred electrical fitters. These men were to be placed under the orders of the torpedo lieutenants, not under the chief engineer, and their qualifications were to embrace a practical knowlelge of machinery generally. Where was the necessity for such knowledge at that time, seeing that all steam-engines, hydraulic machinery, and dynamos were then under the charge of the chief engineer? In the light of the new Admiralty order that henceforth all machinery outside the engine-room is to be in charge of the torpedo lieutenant, the requirement of such qualifications on the part of the new electrical artificer rating is easy to be understood. But what a revelation is this of the solicitude of the Admiralty authorities, that the personnel of the Navy shall be the very best that can be provided. Our cousins across the Atlantic have had a similar difficulty to surmount. We do not find that they have shirked it or gone round the corner to find a way out. No! they have grasped the nettle danger, and have solved the problem in a rational and straightforward manner. They saw that the demands of their naval engineers were just and reasonable, and like sensible business men they granted them fully and generously. As there could be no peace as long as the two branches of the service were striving—the one to maintain its supremacy, the other to obtain justice—the American legislature cut the Gordian knot, by amalgamation. Henceforth, sailor and engineer are equals.

I do indeed rejoice that a large and influential Institution of British engineers and shipbuilders has taken up this important national question, and is dealing with it on the broad and unassailable basis of what is best for the country. That is undoubtedly the line which all speakers and writers must take when approaching any service question. It is the only one which will enable them to hold the balance evenly.

Before concluding, it will perhaps not be out of place if I state briefly what in my opinion are the pressing needs of the engineering branch of the Navy, to place it in a condition of thorough efficiency. There are three points which stand out prominently

before me like headland lights. First, training; second, a sufficient and an efficient staff, and third, an adequate measure of naval authority for the engineer officer.

With regard to the first, it is no exaggeration to say that as far as practical efficient training is concerned it is non-existent. It is true that a training of a kind—I hardly know whether to treat it seriously or not, because when one discusses it with an Institution of Engineers one is expected to treat of things at any rate from a sober and practical point of view, and for some time I was of opinion that some wag had been getting at the Admiralty over this matter. Well, a training has been recently inaugurated at one or two of our principal ports for stoker recruits, consisting of what may very well be termed "shovel, stones and sand drill." The drill consists of filling the furnace of a boiler with stones evenly and equally distributed. The drill is, I believe, carried on by means of numbers, something like this: at the order "one," the recruit stoops down and grasps the shovel firmly with both hands; at the order "two" he plunges it into the heap of stones and sand which lie at his feet on the stokehole plates; at the order "three" he pitches the stones and sand into the open furnace mouth, and so on and so on. I confess that on first hearing of it, I felt half inclined to laugh, but then the pitifulness of the miserable subterfuge struck me with all its paralysing force, and I realised that it was too serious a matter for mirth. Just try and picture the scene, and ask yourselves the question, "What can the raw recruit learn from such a travesty of training, which will fit him to face the roaring fiery furnace of actual service?" In seeking for the genesis of this order I was informed that the proposal emanated from a naval engineer, and considerable mirth

pounds in the training of our blue-jackets, in a trade or profession which is as dead and buried as the dodo, it has never been considered necessary to provide any systematic training for the men who have taken their place in the propelling and manoeuvring of our warships.

With regard to my second point, "A sufficient and an efficient staff;" I think the question has been so thoroughly thrashed out in Mr. Morison's paper that all I need say is that the lowest reliable estimate puts the required increase of numbers at thirty-three per cent. of the existing staff. If we should unfortunately find ourselves involved in a naval war I should expect to find that these numbers had to be still further augmented.

With regard to the third and last point, "An adequate measure of naval authority for the engineer officer;" I have for nearly thirty years advocated amalgamation of the two great branches of the service, and in that matter I was heartily supported by our lamented late Engineer-in-Chief, Mr. Richard Sennett, a name which must be very familiar to many members of your Institution, as it is generally throughout the engineering profession. I observe, however, that as a preliminary step you advocate an independent military corps of engineers. If the absolute efficiency of the engineering department of the British Navy can be secured by the adoption of the proposal contained in your Memorandum, I shall be quite content to relinquish the point, so long as the end desired is attained.

I thank you for the opportunity of expressing my views on this momentous subject, to so influential a body of professional engineers and shipbuilders,

Yours faithfully,

CHARLES M. JOHNSON, R.N.,
Chief Inspector of Machinery (retired).

*February 6th*, 1902.

DEAR MR. DUCKITT,

Mr. Morison's paper is a valuable contribution to the literature of this much-needed reform; it is a clear statement of the case, strengthened by new evidence and bearing the clean-cut stamp of an engineer. As long ago as 1875 the necessity for this reform was precisely indicated by Admiral Cooper Key, in 1877 it was again advocated by Lord Goschen, and in the same year by Sir

Edward Reed. Since that time reformers have been many, the case has been brought repeatedly to public notice, but because it has lacked one piece of evidence it has always failed to impress itself upon the man in the street. I mean that it has lacked the grim evidence that would be immediately forthcoming in the event of naval war, and for this reason it has found no adequate response among the people, and no proper consideration at the hands of the Government. It has been shelved, like the old melodramas of Nelson's time, some day to be re-enacted with terrible force and circumstance. Admirals, statesmen, and the press have urged for these concessions in vain; diplomacy and eloquence are no match for tradition. But now that the lever has been applied by civil engineers, something must shift, and progress must be made; for the public will realise that the present system stands condemned by the men best able to judge of its defects. If the great body of qualified civil engineers makes the statement that the present system spells ruin to the fleet, we may hope for some result. I understand that it is Mr. Morison's desire to obtain an expression of opinion from civil engineers generally—never was technical opinion called for to better purpose.

The case as presented by Mr. Morison is carefully drawn up and leaves little room for criticism. He speaks of "departmental jealousy," meaning of course to call attention to the treatment that the "non-combatant" "civil" branch receives at the hands of a wholly military Board of Admiralty. It may be well to point out that as ship-mates this jealousy is practically never allowed to shew itself between officers of those two branches: there is no more striking evidence than this of the perfect amalgamation that would take place if parity of rank were granted.

Mr. Morison tells us that according to Admiralty regulations, a lieutenant can qualify himself as a torpedo lieutenant, so far as electrical knowledge is concerned, by going through the electrical course of eight working months at Greenwich, during which seven hours weekly are devoted to this subject; finishing up with a preliminary course of three months in H.M.S. "Vernon" and a further practical course of six months in that ship. This is in all seventeen months, a very short term in which to acquire a sound knowledge of electrical engineering. But assuming that this is sufficient, the riddle arises: If it takes seventeen months for a lieutenant to learn electrical engineering, how long will he

require for hydraulics, and for mechanical engineering? The answer is : Five years. This answer will be agreed to by every qualified civil engineer, and it is of special importance to note it at a time when the Board of Admiralty are proposing to hand over to such lieutenants the hydraulic and other gear on deck and elsewhere.

Mr. Morison does not seem to advocate the American system, whereby executive and engineer officers are combined in men of a single type. I am of opinion that a better plan would be to adopt a system of common entry for deck and engineer officers, and for the first two years to submit them all to the same course of training at a Royal Naval University, afterwards by selective methods allowing them to specialise in the various branches of engineering and deck duties. The naval officer of the future must be a specialist at his own particular job—that first, and afterwards, a handy man all round.

Yours faithfully,

ROLLO APPLEYARD,
A.M. Inst. C.E.

*February 12th*, 1902.

DEAR MR. DUCKITT,

Owing to pressure of business at the time of the recent meeting in Newcastle, I am complying with the Chairman's request that those who were unable to speak should send written communications on the subject.

The paper which Mr. Morison has read is one of vital importance to the well-being of the Navy, and everyone must admire the perseverance and pluck with which he has tackled his subject with a view to the reorganization of the engineering branch.

It appears that the engineering branch represents about 27 per cent. of the total naval strength in personnel, and in spite of this the officers remain with no positive rank attached to them, nor have they direct control over their men; such a state of things might possibly continue in a time of peace, but surely the strain of war would inevitably expose such a weak spot in the organization.

The title and rank of the naval engineer is practically unknown to the man in the street.

The question of rank is a very important one and operates to a very much greater extent than would appear on the surface, in

the way of observing discipline and maintaining control amongst large bodies of men. The engineering force in some of our largest cruisers numbers at least 300 men, and in our battleships it numbers 180 to 200. The engineer officer has to maintain discipline amongst his numerous staff under conditions which are unknown on the upper deck, and which are not always appreciated by the deck officers, and certainly are entirely unknown to the general public. One manner in which the want of rank and direct control by the engineer officer over his men operates against discipline is clear from the fact that the men themselves see that their officers are not considered worthy of being entrusted with a proper dignified position, nor yet of being granted means to either reward or punish their own men for departmental matters; this be-littling of the officer in the eyes of his men cannot tend either to respect on their part towards their officer, or towards the maintenance of proper order and discipline amongst the men.

The term of "relative" rank is unknown in the Army, and there does not appear to be the necessity for it in the Navy; real rank seems to be just as much a necessity for a naval engineer as for any officer in the military service of the country; he has control over large bodies of men, who at any time may be brought into active service.

One thing that has struck me on page 97 of the paper is the wide gap in age which appears to exist between the fleet engineer and his next assistant; it is quite possible that in respect of age the assistant may hardly have been born at the time the fleet engineer entered the Navy, and taking as an example H.M.S. "Hannibal" and "Repulse," in the case of the fleet engineer being incapacitated during action the whole of the duties would devolve upon a man of 5½ years' experience only.

tricians, as they are called, who are being entered to look after the whole of the electrical equipment on board ships. Having been all my life connected with electrical machinery of different sorts I certainly think that in the case of warships, which have to keep themselves efficient for a great part of their time on their own resources absolutely, it is of the very highest importance that the electricians should be men of unquestioned skill and experience; the state of things as depicted in Mr. Morison's paper in this respect is most unsatisfactory.

It would appear at present that the Admiralty are experiencing the greatest difficulty in getting men of any qualifications whatsoever to join this new electrical branch. Electricity is daily becoming a greater factor in the war efficiency of our Navy, and surely it would be wiser to continue to entrust the electrical machinery to the people who have hitherto kept it efficient than to risk any inefficiency by placing it in the charge of what appears to be a new rank, possessing, according to the Admiralty's own advertisements, very little, if any, electrical knowledge whatsoever. In the Admiralty's advertisements it states candidates must be good workmen at the lathe, surely the mechanics of the engineering branch possess these qualities to a much higher degree than those they propose to enter. It is alleged by the Admiralty that the reason of the changing of these duties to a new class is that they are short of engineers. The aversion to enter H.M. Service as engineering officers must naturally be a very pronounced one, especially as regards electrical matters, when so very much better forms of employment and chances of success and promotion are to be found in other branches of the electrical engineering profession at home.

Speed is as great a factor in naval efficiency as is the armament of the ship, and it seems to me, therefore, that in reality the engineer is as important a factor as the naval executive officer, and requires military rank to duly control the actions of his men.

As a member of this Institution, I must also add my protest to the very unsatisfactory reply which was made to the engineering and parliamentary deputation of July last, and that a change in this deplorable condition of affairs will have to come appears to be certain, if we are to maintain our first line of defence in the highest state of efficiency.

Yours faithfully,

D. Selby Bigge.

LEEDS FORGE, LEEDS,
*February 18th*, 1902.

DEAR MR. DUCKITT,

As I was unable to be present at the reading of Mr. Morison's paper at Newcastle on the 7th inst., I beg to forward the following remarks upon the subject under discussion—with reference to the much-needed re-organisation of the engineer branch of H.M. Navy:—

I would begin my remarks with the statement that I consider it absolutely necessary that some such change as that advocated in the paper must be made, and that very soon, if the British Navy is to become thoroughly efficient, and ready for immediate war service if required.

The weakness of the organisation of the Navy appears to be due to the attempts made from time to time to bring it up to date. As our Navy increased, and as sails gave place entirely to steam the inefficiencies of the old type became more and more apparent; but instead of a entirely new system being introduced which would take account of the advance of modern naval engineering, the old system has been patched here and doctored there, till neither the engineer officer, the artificer, nor the executive officer is satisfied. The executive officer feels the day fast approaching when he will no longer be as supreme as in the past; the engineer officer feels he is absolutely essential, but is treated as if he were an interloper; and the artificer, knowing the principal work devolves on him, wonders why he is treated like a mechanical doormat. This perhaps is excusable owing to the rapid growth and development of engineering science, as applied to war navies. In every important navy of the world it has lately been made

would, however, venture the opinion that the highest efficiency in any branch of a war navy can best be secured by specialisation. It seems to me that it will be an extremely difficult matter to make all naval officers equally expert, in the highest degree to which expert knowledge can be brought, in all branches of a naval officer's duties; besides it should not be lost sight of, if this could be done, that their value as measured by the salary they could command on shore would be much more than their present position at sea. And for this reason, although I feel sure that the American system of amalgamation will produce better results in the Navy than the arrangement which it has supplanted, I think that much more efficiency will be secured by the formation of a mechanical or engineering corps, on the lines suggested by Mr. Morison; but to make such a corps thoroughly efficient and capable of offering attractions to the youthful engineering talent which this country possesses in an almost unlimited quantity, a re-organisation of the naval engineer branch is absolutely necessary.

The day has now arrived to effect a radical and satisfactory change in this branch of the service, and the naval engineers should be given identity of rank, identity of representation upon the Admiralty Board, identity of authority over and control of the men of their department, and identity of consideration in the rewards and privileges of the naval service that are bestowed upon the present military branch of the Navy. I have referred to the changes which have taken place in the navy of the United States. The navy has, rightly or wrongly, made the change which the wisdom of the American Congress deemed necessary. In other navies, such as the French, or the Russian, the same spirit of discontent and inefficiency exists amongst the officers and men of their engineer branches, and the discontent seems to me to be one of the features of the natural evolution which all navies are undergoing.

So much for general remarks. Mr. Morison has cited some very startling examples of the youth and inexperience of the engineer officers of some of our newest and largest battleships. This juniority on the part of the great bulk of officers below the chief engineers of our warships is a direct result of the undermanning and starvation of the naval steam department. No Atlantic liner or large mercantile marine steamer dare put to

sea under the conditions which are shown to exist in our battleships and cruisers; and yet it may happen, on the declaration of war, that these very vessels would be called upon to do quite as hard steaming as the Atlantic liners now do with unfailing regularity. It would be absolutely suicidal for any of our large steamship companies to send their vessels to sea with such a large proportion of their engine-room complements as inexperienced and youthful as are the engineer complements of many of our finest newly-commissioned men-o'-war, and certainly this unsatisfactory condition of affairs gives much force to the assertion that these things could not happen if the engineers' branch of the Navy had adequate and authoritative representation upon the Admiralty Board.

As things go nowadays, and as they have gone for many a long day, the engine department of the Navy has the least consideration given to it of any department. It has to take, as far as *matériel* is concerned, in weight or space, practically just what the other departments of the naval service do not require; and as far as *personnel* is concerned the same unsatisfactory state of affairs obtains. Small wonder is it, therefore, that trouble always occurs aboard our new vessels of war. I have just been reading the explanatory statement of Lord Selborne on the navy estimates for this year. I find that, although no less than forty-nine vessels of war of various sizes, from battleships and cruisers to submarines, have been added to the Navy during the past year; that, although there are to be no less than sixty vessels of war under construction on the 1st of next April, and that during the next financial year it is proposed to commence the construction of twenty-seven additional vessels of various types, all that it is

It must be remembered too that these men will require a certain amount of training before they can become of much use, and that it takes just as long, if not longer, to train an artificer or a stoker to become efficient as it does to build a vessel.

Mr. Morison's paper touches upon so many points in this detail of organisation of the engineer branch that I hesitate to comment upon them all, but I certainly think he has proved all his conclusions up to the hilt in the admirable paper he has recently contributed to this important subject. I am forcibly struck with the diagrams he has prepared, showing the gradual declination of entries into the engineers' branch. This fact alone proves much more conclusively than any other that the administration and conditions of this department of the Navy is eminently unsatisfactory. The entries of engineers who have been trained in the technical college and in the private engineering establishments of the country appear to have stopped altogether. And further, the competition for engineer studentships at Keyham, where youths are entered at the ages of 14 to 16 years, has decreased to an alarming extent of late years.

There is no getting away from this pitiless array of cold facts, and that this should happen with the engineers' branch, when competition for other departments of the public service is so very keen, and when parents are at their wit's end often to know what to do with their boys, certainly shows the esteem, or rather the lack of it, in which naval engineering is held generally.

It is surely time that a drastic reform should be made, and that naval engineering should be given the honourable position in H.M. Navy which its value and importance entitle it to.

Yours faithfully,

ERNEST GEARING.

# NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

EIGHTEENTH SESSION, 1901-1902.

## PROCEEDINGS.

FOURTH GENERAL MEETING OF THE SESSION, HELD IN THE LECTURE THEATRE OF THE TECHNICAL COLLEGE, HART ROAD, WEST HARTLEPOOL, ON SATURDAY, FEBRUARY 22ND, 1902.

HENRY WITHY, ESQ., J.P., IN THE CHAIR.

The SECRETARY read the minutes of the Third General Meeting of the Session held in the Lecture Theatre of the Literary and Philosophical Society, Newcastle-upon-Tyne, on January 24th, 1902, and also of the Special Meeting of the Institution held in the Lecture Theatre of the Literary and Philosophical Society, Newcastle-upon-Tyne, on February 7th, which were approved by the members present and signed by the President.

The ballot for new members having been taken, the President appointed Mr. J. R. Fothergill and Mr. Tom Westgarth to examine the voting papers, and the following gentlemen were elected:—

MEMBERS.

**Edwards, Robert William, R.N., Naval Engineer, 4, Livingstone Road, Southsea, Hants.**

**Robson, John Hayes, S. Draughtsman, 32, Pollard Street, South Shields.**

**Wynd, William Adam, Naval Architect, 8, Dilston Terrace, Gosforth, Newcastle-upon-Tyne.**

GRADUATE TO MEMBER.

**Olsen, Hans B., Jun., Engineer, Victoria Road, West Hartlepool.**

GRADUATES.

Nichol, Robert, Apprentice Engineer, 9, Abbey Street, Gateshead-on-Tyne.
Sanson, Robert D., E. Draughtsman, 20, Granville Street, Gateshead-on-Tyne.
Schaeffer, Paul P., Engineering Student, Portland Villa, Forest Hall.
Wilson, William, Apprentice Engineer, 117, Bede Burn Road, Jarrow-on-Tyne.

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## NOTES FROM THE COUNCIL.

The PRESIDENT—There are certain notes from the last Council Meeting that I have to put before you.

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Mr. Robert Thompson, Past-President, having been elected a member of Lloyds' General Committee, has resigned his seat as one of the representatives of the North-East Coast District in Lloyds' Technical Sub-Committee and the Council has elected Mr. W. H. Dugdale, Vice-President, to fill his place.

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A letter was received from Mrs. Marshall, wife of Mr. F. C. Marshall, one of our Past Presidents, saying that owing to ill-health Mr. Marshall was compelled to resign his membership. The Council thought, considering the great services Mr. Marshall has rendered to the Institution, that it would be very fitting to appoint him a Life Member, and that has accordingly been done.

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The Institution of Mechanical Engineers having decided to

Awards to Graduates:—The following awards have been given in the Graduate Section for papers read during the last Session:—The sum of £3 to Mr. George Nelson for his paper on "The Design of Large Thrust Blocks;" the sum of £2 10s. to Mr. R. Robson for his paper on the "Wiring of Ships for Electrical Installation;" the sum of £2 to Mr. H. B. Donaldson for his paper on "The Construction of a Modern Merchant Steamship."

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The discussion on Mr. E. C. Chaston's paper on "The Ballasting of Modern Tramp Steamers" was resumed and adjourned.

The discussion on Mr. F. J. Warburton's paper on "Some Notes on Steam Turbines" was opened and adjourned.

Mr. D. B. MORISON replied to the discussion in his paper on "The Present Unsatisfactory Condition of the Engineering Branch of H.M. Navy."

Mr. M. C. JAMES read a paper on "Passenger Accommodation in Steamships."

## ADJOURNED DISCUSSION ON MR. E. C. CHASTON'S PAPER ON "THE BALLASTING OF MODERN TRAMP STEAMERS."

Mr. J. R. FOTHERGILL (Vice-President) said—I regret that Mr. McGlashan is not with us to-night, because he had intended to speak on this paper. We all remember the paper he read with so much interest, and being so conversant with the whole subject it would have been interesting to hear his remarks. I agree very fully with Mr. Chaston's paper, and I think it may be said to be a most interesting and a most important one. The question of ballasting steamers when light, and insuring their having a reasonable and safe draught, is an underwriters' question, and one that can be readily dealt with by them on the lines mentioned a few days ago at a meeting of underwriters in Liverpool. If anything has to be done in the nature of assigning a light line freeboard then the Board of Trade and Lloyds would undoubtedly have to act; but this necessity would be entirely due, as in the case of the load line, to the absolute indifference of owners to act themselves, and owners would certainly find it more to their interest to do something to meet the requirements than allow the whole question to drift into the hands of the Board of Trade and Lloyds. Mr. Chaston has shewn many serious results to steamers in ballast due to the small percentage of ballast carried; and those who are at all conversant with steamers cannot help but fully realize the serious nature and the possibilities of accident, due to want of deeper draft in light ships. The greatest risk is not so much in crossing the Atlantic, because as a rule additional ballast, generally sand, gravel, etc., is taken on board. They leave with a considerable quantity of bunkers, which in itself has its effect in ballasting the ship, although as the passage proceeds you burn up your bunkers. But probably the danger is greatest when coming from the continent say to Cardiff. You come down Channel with a fair wind and you no sooner turn the Land's End than you get a head wind with probably a nasty chop of an Atlantic sea, and drawing so little water the position

becomes dangerous and the machinery suffers materially. No doubt the majority of those who are acquainted or associated with steamers have comprehended that position, but it is imperative that the shipowner should realise—not only the danger to ship and machinery—but that it pays him to ballast his ship even for a short voyage. When recently down at Cardiff and Barry during my visit a number of steamers coming from continental ports took in some cases 14 or 15 days to make the passage. The loss of that time is a very serious matter indeed to the shipowner. If shipowners took the question up from no other consideration than that of economy, so far as the trading of the ship is concerned, it would pay them to provide for suitable ballasting. The question of the best nature and application of ballast it is not my intention to touch upon, but it is most desirable to emphasize, and strongly emphasize, the interest that owners themselves would gain by ballasting their ships when light. I fully endorse the value of this paper.

The subject was adjourned until next general meeting for Mr. Chaston's reply on the whole discussion.

## ADJOURNED DISCUSSION ON MR. F. J. WARBURTON'S PAPER ON "SOME NOTES ON STEAM TURBINES."

The PRESIDENT invited further discussion on Mr. F. J. Warburton's paper on "Some Notes on Steam Turbines."

Professor R. L. WEIGHTON (Vice-President) said—I have just had an opportunity of having a conversation with the writer of this paper, and I have had the questions I intended to ask answered. But in order to give Mr. Warburton an opportunity of satisfying the possible curiosity of other members I may say the particular question I wished to ask was as to the efficiency of this turbine going astern. Of course it is well known that Parsons' turbine is irreversible, and it is a very important matter to get a turbine to reverse at all. This one is reversible, and in a paragraph on page 76 it is said that the go-ahead set of nozzles plays on the most efficient side of the wheel vanes. The question I asked had regard to the efficiency of going astern. It is obvious to anyone that when the turbine is going astern the steam jets are playing on the reverse sides of the blades, which sides have a curvature which seems to me to be less adapted for efficiency than even radial vanes would be.

Mr. P. MAYSON BENNETT said—On congratulating Mr. Warburton on his paper one cannot but feel the magnanimity with which he has put before the Institution the details of his invention and experiments. Unlike some inventors Mr. Warburton evidently does not believe in the, to my mind, fatal policy of "hiding one's light under a bushel," but exposes it to the full blast of the engineering profession. If it is strong enough it will not be put out. In speaking of the shapes of orifices Mr. Warburton does not say to what extent the velocity of flow is affected by the length and shape of the nozzles, which he says are calculated. Does this shape approach the hyperbolic curve, and is the formula for velocity of the form—

$$v^2 = \frac{2g}{c} - \frac{\gamma}{\gamma - 1}\left(p_0 \frac{\gamma - 1}{\gamma} - p^{\frac{\gamma - 1}{\gamma}}\right)$$

where $v$ = velocity in feet per second; $p_0$ and $p$ = pressure inside and outside orifice; $c = \frac{w_0}{p_0}$; where $w_0$ = weight of a cubic foot inside; $\gamma$ = ratio of specific heat at constant volume and pressure? The angle of nozzle to vane, *i.e.* 20°, agrees, I believe, to some extent with that taken in the Parsons' steam turbine, in which the "angle of approach" is somewhere about 20° and the "angle of exhaust" is about 90°. The theory that the speed of vanes, being half that of initial steam, will leave exhaust steam relatively motionless is very nice, but how does this come out in practice? I would suggest that there is a certain amount of "slip," greater at full load, which must leave the steam with some velocity, and this must produce frictional and eddy current losses in the exhaust chambers of each element. Mr. Parsons' steam turbine takes advantage, not only of the impulse or momentum of the steam as in De Laval, but also of the expansion which takes place throughout the whole length of cylinder as though it were a huge nozzle, whereas this expansion is entirely lost in the impact turbine as described by the author.

Mr. Warburton gives 12½ pounds per B.H.P. expected with the impact turbine of the Rateau patent; what consumption does he get with his turbine?

I believe Mr. Parsons' turbines give a consumption of:—

18 to 25 lbs. per K.W. hour, or
13·5 to 18·7 lbs. per E.H.P. hour, or
12·8 to 18·2 lbs per B.H.P. hour, or
10·8 to 15·2 lbs. per I.H.P. hour.

allowing an efficiency of:—

75 per cent. K.W. to E.H.P.

not put enormous strain on the working parts? What leakage occurs past isolation rings, which Mr. Warburton states do not rotate, but float on a thin layer of steam? If they have weight, is it not against the theoretical laws of a fluid that it should support the weight of these rings, *i.e.*, the weight of ring is supported by upper layer of steam, which is consequently at a greater pressure than the fluid in the lower portion? Centrifugal action may produce this floating, and from the specimen which Mr. Warburton submitted to view at the last meeting it would seem that no frictional wear had taken place. From the sectional drawings of the engine one cannot judge very well as to its mechanical construction, and I shall be glad when I am able to see one of these compact and interesting steam turbines at work.

The discussion was adjourned till the next meeting.

The following communications have been received by the Secretary:—

RUTHERFORD COLLEGE, NEWCASTLE-UPON-TYNE,
*January 28th*, 1902.

DEAR MR. DUCKITT,

I have read with much interest Mr. Warburton's paper on steam turbines, but am sorry to see that he has given no experimental results on those he describes. In the design of water turbines, much use is made of a quantity called the hydraulic efficiency, which is the ratio of the work done by the water on the wheel, per pound of water, to the total fall of water in feet; a similar quantity which would be of great service in the design of steam turbines would be the ratio of the work done per pound of steam on the wheels to that which would be obtained from the steam in an ideal engine working in Rankine's cycle. From experiments published on Mr. Parsons' turbines I have obtained three values of this quantity. The Eberfeld trials give it as ·708, and those by Mr. W. Hunter, engineer to the Newcastle and District Electric Lighting Company, made in January, 1897, give ·576, and ·59 for non-condensing engines, the latter supplied with super-heated steam. In making these calculations, I have allowed mechanical efficiencies of ·95 for the dynamo and ·85 for the

turbine, as the consumptions of steam are given per electrical horsepower. It would be of great interest if Mr. Warburton could give some of the results of experiments made by himself on steam consumption from which this quantity could be calculated.

Yours faithfully,
C. H. INNES.

BADEN,
SWITZERLAND,
*February 17th*, 1902.

DEAR MR. DUCKITT,

I have carefully read the interesting paper recently delivered by Mr. Warburton before the Institution, and regret I will be unable to be present at the discussion.

As there are one or two points in the paper on which I should like to make a few remarks, I should be obliged at your placing this letter before the Institution at your next meeting.

With reference to the Rateau turbine, which has been so extensively advertised of late upon the continent and in England also, excellent steam consumptions, surpassing in some cases those actually obtained by Parsons' and by the best reciprocating engine-builders, are being claimed. As the progress of this engine is naturally being watched with keen interest both at home and abroad it is indeed disappointing that no actual results of tests should appear. The machine of 1,200 H.P. mentioned in the paper as being actually completed and run, together with the fact that it has led to the construction of another 50 per cent. larger, seems, however, to show that this engine has now resolved itself, to quote the author's language, into a market-

My principal reason for dwelling on this point is that during my visit to Paris, at the time of the exhibition, I found it absolutely impossible to obtain any satisfactory information regarding Rateau turbines actually at work. It may be mentioned that a stall was set apart for the exhibition of this machine, but only individual parts were to be seen.

It also strikes me as being curious that, in spite of the favourable criticisms that appear from time to time in the continental press, no one has ever been able to tell me where a turbine of this type is at work.

Perhaps Mr. Warburton or some other gentleman would give us some definite information, thereby removing the doubts that have so long existed in continental engineering circles that the Rateau turbine has not yet passed the laboratory stage.

Concerning the other turbines mentioned in the paper, it is to be regretted that the author did not give us any data as to the results of these new engines and I hope that before long he will give us some actual figures, which are of the greatest interest after hearing the description of any new machine.

There is one other point on which I should like some information. In the advance copy of the paper a turbine is described as stopping from and reversing to 4,000 revolutions per minute in the wonderfully short space of time of five seconds. Considering that the kinetic energy or flywheel effect of a mass of 1 pound at a radius of 1 foot rotating at the above-named speed is something like 2,750 foot-pounds, it would be interesting to know what was the size of the engine in question, whether it was any the worse after this severe strain, and whether such a reversal is possible under ordinary working conditions.

Hoping I have not encroached too much upon your valuable time, and thanking the author for his interesting paper,

Yours faithfully,

W. J. A. LONDON.

## MR. D. B. MORISON'S REPLY TO THE DISCUSSION ON HIS PAPER ON THE "PRESENT UNSATISFACTORY CONDITION OF THE ENGINEER BRANCH OF H.M. NAVY."

Mr. D. B. MORISON (Vice-President) said—The most gratifying feature in connection with the paper I have had the honour of submitting to this Institution is, that it has resulted in expressions of opinion from several gentlemen well known in the engineering world, who are undeniably qualified to form reliable conclusions on the great national problem of naval engineers and naval efficiency.

The importance of the subject is ably set forth by Mr. C. M. Johnson, R.N., Chief Inspector of Machinery (retired), who says, "The efficiency of the Navy is so intimately entwined and bound up in the engineering branch, that the safety of the nation may be secured or forfeited by the action which the authorities may take, or may not take, on the initiative of the North-East Coast Engineering Institution."

For years the Admiralty has been advised and entreated to deal with the engineering question in a broad, liberal and impartial spirit, but in the words of Mr. Dugdale "they have by arrogant and egotistical opposition succeeded in making one of our most honourable and important professions, the most unpopular in the entire Navy." Reference to the diagrams included in my paper testify to the truth of these severe criticisms, and it is evident that the authorities must either refute the alleged facts, or stand convicted of a grave dereliction of duty.

Two years ago this subject was discussed in plain and unmistakable language by the marine engineering institutions, but the fact that practically nothing has been done is a clear indication of the bitterly hostile attitude of the all-powerful opponents of engineering reform. There is no attempt to disguise the hostility, it is traditional and intense, and will remain so as long as the constitution of the Board of Admiralty is wholly executive.

Opposition to naval developments, on the part of admirals who serve on the Board, has always been a factor to be reckoned

with. They opposed steam, opposed armour, opposed breech-loading and quick-firing guns, opposed the increase of the fleet, opposed the removal of masts and yards, but they undoubtedly did so from an honest conviction that they were acting in the best interests of the country, and the explanation is, that they were then, as they are now, completely out of touch with engineering progress.

Sir John Colomb, M.P., at the interview with Lord Selborne, said, "We have arrived at the present stage of dissatisfaction and difficulty through a long series of administrative compromises between the force of sentiment and tradition on the one hand, and the force of facts produced by the progress of mechanical science on the other."

This may explain the attitude of Lord Selborne towards the parliamentary and engineering deputation. On that deputation were a large number of influential members of the House of Commons, and also the representatives of the engineering institutions.

The gentlemen who addressed Lord Selborne undoubtedly expressed the views of the marine engineering profession, and yet a perusal of his lordship's reply clearly shows how hopelessly out of sympathy are the members of the Board of Admiralty with the engineering profession generally. Lord Selborne's opinions on this highly technical question are naturally inspired by his executive colleagues. It is from them he derives his knowledge of the internal economy of the naval service, and to him they impart those prejudiced views, on this very question, which are so effectually blocking reforms, and which have established a position wholly artificial and highly dangerous.

ality and justice. The more one ponders this subject, and the closer one examines it, the more firmly does one become convinced that the Admiralty has, so far, failed to fully realise the essential character of the machines they administer.

"A modern warship is a floating box of machinery. It is the greatest, and most awe-inspiring aggregation of power in one unit yet devised by man. On its operation on the day of stress may depend the security and even the very existence of the Empire. Naval tactics are necessarily of the utmost importance —they are of primary importance—but futile indeed will be the most brilliant tactics, if the floating mechanisms fail in the hour of trial. To minimise the risk of such failure, it surely behoves the Admiralty to adopt all possible precautions. They have at their service the highest marine engineering talent the country can produce, if they like to enlist it. They require this talent, and they require abundance of it, not only afloat, but at headquarters ashore."

In dealing with the subject of administration in this year's report on the Navy Estimates, Lord Selborne says:—"Most important of all, the development of the peace administration must be on such lines as make for efficient war administration. The Board are keenly alive to the importance of this aspect of the question."

The great reform which is absolutely necessary for the efficiency of the Navy is, that engineer officers should be placed in military control over their men. After a life's experience in the Navy, Mr. Bedbrook, R.N., Chief Inspector of Machinery (retired), said, at the Newcastle meeting:—"The position of the engineer officer should be such as to demand implicit obedience from all naval ratings, and this is only possible by his being given a military command. It should further be borne in mind that engineer officers have a large number of petty officers and men serving under their orders, and that they with their men are called upon to submit to risks greater than many others of their shipmates, in view of the probability of the boilers, engines and steam pipes being damaged by shot or shell or torpedo; and the possibilities of the vessel being rammed. I may remark, for instance, in the case of the 'Victoria,' not in war time, only one engineer officer was saved, whereas only one lieutenant was drowned; and we know with regard to the unfortunate men a

large proportion of the engineering department perished in that ill-fated ship. It is consequently necessary that the engineer officers should exhibit to their men an example of courage and coolness for the preservation of discipline and the ensuring of prompt attention and obedience to orders, but it becomes difficult to exhibit these necessary qualities if the spirit of these officers is crushed by the continual repression and non-recognition by those in authority."

Mr. Rollo Appleyard says:—"As long ago as 1875 the necessity for this reform was precisely indicated by Admiral Cooper Key. In 1877 it was again advocated by Lord Goschen, and in the same year by Sir Edward Reed. Since that time reformers have been many, the case has been brought repeatedly to public notice, but because it has lacked the grim evidence that would be immediately forthcoming in the event of naval war, it has found no adequate response among the people, and no proper consideration at the hands of the Government. It has been shelved, like the old melodramas of Nelson's time, some day to be re-enacted with terrible force and circumstance. Admirals, statesmen, and the press, have urged for these concessions in vain; diplomacy and eloquence are no match for tradition."

With reference to these exceptional admirals, Mr. Bremner says:—"Certain admirals after retiring from the Board have been seized with an attack of virtue, and have given unmistakable expression to their opinion that what the engineers are asking for is perfectly reasonable, but what we want is that the admirals who are in power on the Board at the present time, shall find salvation. Those are the men, and these explosions of virtue which take place when the restrictions of active service are removed are some indication of the strength of the written and

The decision of the Admiralty to appoint warrant officers in full charge of machinery should undoubtedly be considered in conjunction with Admiral Melville's experience and recommendation. I do not infer that artificer engineers are not capable warrant officers but I strongly contend that their services would be of maximum value on ships carrying engineer officers, and especially is this the case in view of the lowering of the standard of experience of artificer engineers recently ordered by the Admiralty.

In the next paper on this subject which I hope to submit to the Institution, I propose to devote a section to the questions asked in the House of Commons on engineering matters, together with the replies given by the Admiralty.

In conclusion, I would again thank the special committee and the many gentlemen who have given me their whole-hearted assistance during the preparation of my paper, and have recorded their opinions so forcibly in the discussion. We have undertaken this work from a national standpoint and the public expects us to do our duty by carrying it through. Mr. Appleyard says:—"Now that the lever has been applied by civil engineers, something must shift, and progress must be made; for the public will realise that the present system stands condemned by the men best able to judge of its defects.

"If the great body of qualified civil engineers makes the statement that the present system spells ruin to the fleet, we may hope for some result."

That the public has lost confidence in the Admiralty methods is clearly proved by my diagrams, but I strongly suspect that many parents will speculate on the ability of the engineering Institutions to solve this problem, and that we shall see an increase in the number of applications for Keyham college this year. If such is the case then we have still another reason for persistence. Our cause is a good one; we are fighting for the efficiency of the British Navy.

The PRESIDENT (Mr. Henry Withy) said—In reviewing the valuable paper of Mr. Morison, which was read before the North-East Coast Institution of Engineers and Shipbuilders, at the Literary and Philosophical Institution at Newcastle-on-Tyne, on the 7th inst., I am sure I can say that everyone must have been

very vividly impressed with the importance of the matter dealt with in that paper, and its bearing upon the efficiency of our Navy. I need scarcely remind this meeting that this last paper of Mr. Morison's forms a continuation of the paper on the "British Naval Engineer," which was first of all read before the Institution at Newcastle the year before last, and which was subsequently discussed by the Institute of Marine Engineers at London and Cardiff. Mr. Morison also contributed another paper entitled "The Engineering Crisis in the Navy," which was read and discussed by the Institute of Engineers and Shipbuilders of Scotland. As a result of the great interest—which was naturally taken in naval engineering matters by all these Institutions—and the importance of the serious defects known to exist in our naval engineer administration, a large and influential deputation of members of Parliament, and officials and representatives of the North-East Coast Institution of Engineers and Shipbuilders, and the London and Cardiff branches of the Institute of Marine Engineers, thought it their duty to place the unsatisfactory condition of the engineer department of H.M. Navy before the attention of Lord Selborne and his colleagues at the Admiralty. I may mention in this connection that about 50 members of Parliament signified their appreciation of the magnitude of the national interests involved in the question, by assenting to form part of the above deputation and many of them attended personally at the Admiralty on that occasion. Although that took place as long ago as last July, no answer beyond the few remarks which were made to the deputation by Lord Selborne, has been vouchsafed by him, and the matter practically remains where it stood when Mr. Morison with the energy and determination which

in marine engineering is due entirely to the genius, skill and determination of the mechanical engineers of the United Kingdom. We, therefore, as engineers, feel it our plain and imperative duty to insist that the engineering branch of the Navy shall be made capable of bearing satisfactorily the first brunt of a naval war, and of efficiently continuing the naval service of the country. No one can know better than the members of this and kindred Institutions, that in these days of steam engineering the safety of our Empire may hang upon the initial efficiency of our naval engine-rooms on the outbreak of war. What we have to insist upon is the paramount value of complete efficiency in our warships, either with regard to their machinery or with regard to the organisation and administration of the officers and men who are entrusted with its care and maintenance. We believe that the highest engineering efficiency of a warship is to be secured by entrusting the machinery to the care of engineer officers who shall have, under the supreme authority on board the ship—the Captain—the military control and management of their own particular department. We have, therefore, in accordance with the resolution which was passed at the meeting held at Newcastle on the 7th inst. considered and adopted a Memorandum embodying the salient points of the matter dealt with in the paper of Mr. Morison, read on that date, and of the subsequent discussion. This Memorandum it is intended to forward to Lord Selborne, as embodying the views of the members of the North-East Coast Institution of Engineers and Shipbuilders.

Mr. Morison has shown in the most graphic and telling manner, by the diagrams which he published at the end of his paper, the rapid decline of candidates for engineer appointments. It is necessary for the efficiency of the Navy that this should be altered, but it never will be altered until the engineer branch is represented upon the Admiralty Council and until naval engineering is given the status which its importance entitles it to. The work of the engineer is most arduous, exhausting and important. Because it is performed below decks, out of sight, it is often out of mind.

Gentlemen, I cannot say how highly I appreciate the magnificent efforts which Mr. Morison has put forth in this matter, and I am sure that in the end he will carry his point, and that

he has done so will be a matter of proud congratulation to the North-East Coast Institution in particular, and the engineering profession of the country generally. We thank Mr. Morison for his paper.

The following Memorandum was put to the meeting and adopted.

(1.) The engineer branch, in spite of the fact that it comprises nearly one-third of the total personnel of the Navy, and consists of 27,439 officers and men, performing duties upon which the mechanical efficiency of the Navy depends, is totally unrepresented upon the Board of Admiralty.

(2.) The present civilian status of the engineer branch deprives its officers of the necessary military control over their men, and is not conducive to the attainment of that high standard of discipline in the engine-rooms and stoke-holds which will be of vital importance in time of war.

(3.) The non-representation of the engineer branch upon courts martial, when officers or men of that branch are being tried for technical offences, is an anomaly and an injustice, which is detrimental to the true interests of the Navy.

(4.) The existing numbers of engineer officers, artificers, and stoker ratings fall so far short of the actual requirements that it is impossible to provide ships with engine-room complements of the numbers, skill and experience necessary for the proper working and maintenance of the machinery.

(5.) The results of the unsatisfactory conditions of service in the engineer branch of H.M. Navy are, that an adequate supply of qualified candidates is not forthcoming and that a feeling of discouragement exists amongst the engineer officers, which is most detrimental to the efficient performance of their duties. The extreme unpopularity of the engineer branch can be gauged by the fact that at the January examination for engineer officers no candidates presented themselves, and in March there were two candidates, but only one was accepted.

(6.) The discouraging stagnation in promotion to the rank of "chief engineer," whereby officers are not advanced to that rank until they are 37 or 38 years of age, should be remedied, especially as the officers of the executive branch can obtain equivalent rank at ages varying from 27 to 32. Closely associated with the stagnation of promotion to chief engineer rank, is the system of appointing officers of junior rank " in lieu of chief engineers," without according them the rank and pay of chief engineers. By the acceleration of

the engineer officer should also be appended to all official documents relating to the engineer branch, thereby putting an end to the existing suppression of the signatures and individuality of the engineer officers.

(11.) The proposed transference of the care and maintenance of hydraulic, electric and torpedo machinery to executive officers, on account of the shortage of engineer officers and men, is a step fraught with grave danger to the mechanical efficiency of the fleet.

(12.) The obvious, and only effective remedy, would be to increase the engineer branch, and not to create a multiplicity of semi-mechanical departments in our war vessels.

(13.) The present conditions of service of the engine-room artificers are unsatisfactory with regard to accommodation and remuneration, and should be remedied.

(14.) The absence of any satisfactory action by the Board of Admiralty in response to the representation of the Parliamentary and engineering deputation, which waited upon the First Lord in July, 1901, leaves the engineering institutions no alternative but to prosecute their efforts in the cause of reform until the existing evils and their attendant dangers to the Empire have been removed.

The PRESIDENT—It now merely remains for me to tender to Mr. Morison on your behalf our sincere thanks for the labour he has spent upon this paper.

The resolution was carried by acclamation.

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## COMMUNICATION FROM MR. MORISON REFERRING TO THE STATEMENTS ON THE SUBJECT OF NAVAL ENGINEERS MADE BY MR. ARNOLD FORSTER (SECRETARY TO THE ADMIRALTY) IN THE HOUSE OF COMMONS, DURING THE DEBATE ON THE NAVY ESTIMATES, FEBRUARY, 1902.*

(1) "*I believe that the difficulties that exist in this country are less both in quality and in degree than the difficulties which have arisen elsewhere, and are perplexing the authorities of other countries.*"

If this is in accordance with facts, then the difficulties of solution are also less and should be grappled with before they attain a greater magnitude.

(2) "*We do not find complaints from officers commanding ships of the condition of their engines.*"

This is a tribute to the loyalty and zeal with which the engineer officers and their men endeavour to carry out their duties under the existing trying conditions. They can but do their best and they do it. The labour involved in maintaining efficiency of

* Mr. Arnold Forster's statements in *italics*.

machinery seems to be ignored, but its amount can be gauged by the cost of repairs. The following extract from the speech of Mr. W. Allan, M.P., in the House of Commons, on the Navy Estimates, is, therefore, of striking interest:—"A sum of £2,195,528, has gone in one year in repairs, or what is commonly known as reconstruction, whatever that meant." The immensity of this sum affords an indication of the condition of the machinery in some of H.M. ships, and of the worries and anxieties of those responsible for the maintenance of its efficiency.

(3) "*We do not find that when a strain is put upon the engineers they have failed to respond to it.*"

That the engineer officers are not always able to respond even to the intermittent strains of peace times is beyond question. H.M. "Hermes" (see page 130) is a case in point. The chief engineer broke down under the great physical strain, the engineer department utterly collapsed, with the deplorable result that this modern warship had to be towed into Bermuda. The health of the chief engineer was ruined and he has since been invalided from the service.

In war time this disaster will be repeated again and again under existing conditions, and yet those in authority ignore the repeated warnings of the engineering profession, and misinterpret all endeavours to obtain greater efficiency.

(4) "*They did not find that absence of authority had led to indiscipline in the engine-room.*"

The *Times* and other reports of Mr. Arnold Forster's speech contained this statement, but he has omitted it in the Hansard version. The statement is a distinct admission that there is an

materiel, to a degree of danger, which (in their entire ignorance of engineering requirements) they cannot appreciate, but which is, nevertheless, of such a magnitude as to be incredible. Admirals who have studied this great question realise its grave importance. Admiral Sir J. O. Hopkins, G.C.B., in a paper submitted to the United Service Institution, remarks:—

> And now let me touch on the vexed question of the position of the engineers, and suggest that the time has arrived to accord them executive rank.
>
> Their duties are purely executive and should be recognised as such, and the recognition cannot, in my opinion, clash in any single instance with the other executives, as their sphere of duty is so clearly defined, and an engineer would as little expect to be put in charge of the navigating or officer of the watch's duty, as would these officers of being put in charge of the engines.

Admiral Fitzgerald, in a contribution to the *National Review*, also makes the following significant statements:—

> Already the engineers are calling out for executive rank and executive titles. This is quite natural, as they see they do most of the work, and that the maintenance of our modern ships in a state of fighting efficiency is the business of mechanics and not of sailors.

Why the Admiralty refuse to give engineer officers military rank with a limited military control over their men is beyond comprehension in view of the immense issues at stake. Every thinking man must admit that this reform will result in a higher standard of discipline, and in no part of a warship when in action is the highest obtainable standard of discipline more essential than in the engine department. The hostile attitude of the Admiralty on this question is also responsible for the deplorable fact that engineers of education and experience positively refuse to join H.M. Navy as civilian officers. It is rumoured that the next irritating subterfuge devised at the Admiralty will be to alter the titles of engineer officers in service documents so that Mr. Smith, engineer, R.N., will become Engineer Smith, R.N. The value of the change is *nil*, as it conveys nothing to the 26,000 men under their orders. One wonders if it ever occurs to those who scheme these petty evasions, that they are trifling with the efficiency of the Navy of the British Empire.

(5) "*Three more of the highest posts open to engineers are to be created—Chief Inspectors of machinery.*"

The following appears in *Engineering*, February 28th, page 288:—

Mr. Arnold Forster in his opening statement on Friday last, devoted several minutes to the engineering branch, and took much credit to himself and his colleagues on the Board that "three more of the highest posts open to engineers will be created—chief inspectors of machinery." It is needless to remark that the "concession" to engineer officers is absolutely trivial. Out of the whole number of engineer officers now enrolled, each man has a three hundred and thirty-third part of a prospect of gaining a step in promotion towards the end of his career. This fraction of a chance is the average. Of course, the young men just entering the service have a far smaller share than the seniors, who are nearer the goal. There would naturally be the corresponding opportunities for promotion lower down were it not the Admiralty have an unpleasant way of appointing junior engineer officers for responsible positions without giving them promotion or advanced pay, on the plea that they are only acting "in lieu of" officers of the position which the duties demand.

(6) "*These Officers (the Chief Inspectors) will retire with the rank of Rear Admiral.*"

Engineer officers in H.M. Navy throughout their career remain plain Mr. and are retired as civilians with no mark or outward sign whatever to denote that their lives have been spent as officers in a military service. Their so-called rank is a sham. Endless instances may be given to show the sharp line of demarcation between officers of relatively the same rank. If, for example, one of these chief inspectors of machinery served on a board of enquiry, of which a captain was also a member, and each went on board the ship on which the enquiry was held, the captain would be received by a guard of honour, as a mark of respect for the position he occupies, and the uniform he wears, but the chief inspector of machinery would go on board as a civilian and would receive no such recognition, although wearing a uniform identical with that of the captain with the exception that he would have no curl in the braiding of his coat sleeve. And yet Mr. Arnold

active list, and in the engineering branch there is only one officer, the engineer-in-chief, who has a nominal rank equal to the most junior of them. There are also 204 captains in the executive branch, but in the engineer branch there are only 30 officers of an equal nominal rank including the ten now added.

(8) "*We have given a further allowance to the engineer officer of the flagship, even where there is an inspector of machinery on board.*"

It is not a further allowance. If granted in full it will be but the restoration of a former allowance of which these officers—some 8 in number—have been lately deprived.

(9) "*We have also increased the allowance to the officer in charge of torpedo boat destroyers from* 2*s. to* 3*s.*"

This extra allowance of one shilling per diem is given to the engineer officer in consideration of the extra clerical work in taking charge of the stores, not only for his own department, but for those of the boatswain, carpenter, gunner, naval ordnance, torpedo and medical, in fact all the stores on the ship. This extra shilling is less than is paid to an executive officer of equal rank who takes charge of stores on warships of the larger classes, such allowance ranging from 4s. to 1s. 8d. per day.

(10) "*We have increased the number of artificer engineers from* 133 *to* 200."

All engineers will agree that artificers should receive the same opportunities of advancement to warrant rank as men in the executive department, but it must not be lost sight of, however, that these 67 men cease to be *workers* when they become warrant officers, so that, unless their places are filled by men equally competent as workmen, the standard of the artificers will again be lowered, and we have Chief Inspector of Machinery Bedbrook as a reliable authority for the statement that the average artificers now being accepted for service in H.M. Navy are of a lower standard as skilled workmen than at any period during the last 30 years.

(11) "*We have allowed engine-room artificers to obtain warrant rank at an earlier age than formerly.*"

This step will meet with general approval as there can be no doubt that the services of capable artificer engineers will be of

great value on ships of large power carrying commissioned engineer officers, and in which there must necessarily be continuous overhauling and minor repairs in order to maintain a high standard of mechanical efficiency. The Admiralty are most certainly wrong if they assume that there is no distinction between a highly scientific engineer officer and an artificer. Individuals of both classes may overlap, as an artificer of exceptional ability may lift himself up to the plane of an engineer, but the truth is undoubted that as a whole the two classes are absolutely distinct. Not only is it true that the naval engineer officers cannot be replaced by artificers, but it is equally true that the engineer officers cannot exactly fill the place of the artificers, who are, or should be, trained and skilled handicraftsmen. Both hold their worthy and necessary place, with the engineer officer superior in all that breadth, resource and capacity which goes with higher development. Admiral Melville after practical experience in the United States Navy severely condemns the practice of putting artificer engineers in full charge of machinery, yet the following ships in H.M. Navy are in entire charge of artificer engineers and carry no commissioned engineer officer, viz.: —

TABLE I.—THE FOLLOWING SHIPS IN H.M. NAVY CARRY NO COMMISSIONED ENGINEER OFFICERS AND THE MACHINERY IS IN CHARGE OF ARTIFICER ENGINEERS (WARRANT OFFICERS).

| Name of Ship. | I.H.P. | Type of Boilers |
|---|---|---|
| Alert ... ... | 1,400 | Cylindrical. |
| Bramble ... ... | 1,300 | Yarrow Water-tube. |
| Britomart ... ... | 1,300 | Yarrow Water-tube. |
| Cockatrice ... | 1,000 | Cylindrical. |
| Condor (lost) ... | 2,100 | Belleville Water-tube. |
| Contest ... ... | 4,400 | White Water-tube. |
| Curlew ... ... | 1,200 | Cylindrical. |

TABLE I.—*Continued.*

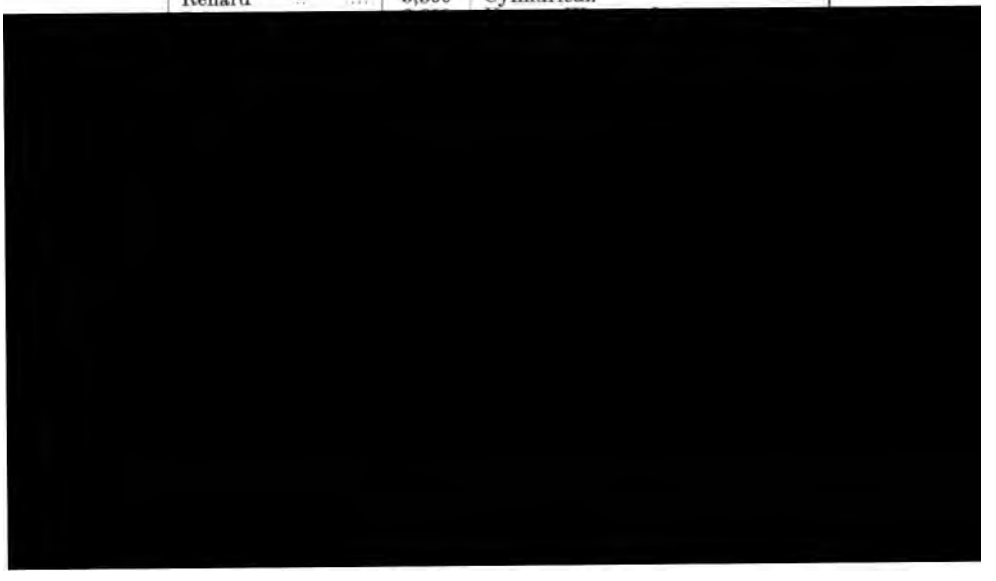
| Name of Ship. | I.H.P. | Type of Boiler. |
|---|---|---|
| Lizard | 1,000 | Cylindrical. |
| Lynx | 4,400 | Normand Water-tube. |
| Magpie | 1,200 | Cylindrical. |
| Melita | 1,200 | Cylindrical. |
| Mutine | 2,100 | Belleville. |
| Opossum | 4,000 | Yarrow Water-tube. |
| Partridge | 1,200 | Cylindrical. |
| Penguin | 1,050 | Cylindrical. |
| Porcupine | 3,900 | Reed Water-tube. |
| Rambler | 975 | Cylindrical. |
| Ranger | 4,000 | Yarrow Water-tube. |
| Rattler | 1,200 | Cylindrical. |
| Redbreast | 1,200 | Cylindrical. |
| Rinaldo | 2,100 | Belleville Water-tube. |
| Rosario | 2,100 | Belleville Water-tube. |
| Seagull | 4,500 | Niclausse Water-tube. |
| Seahorse | 1,650 | Cylindrical. |
| Sharpshooter | 4,500 | Belleville Water-tube. |
| Shearwater | 2,100 | Belleville Water-tube. |
| Sheldrake | 4,500 | Babcock and Wilcox Water-tube. |
| Snapper | 3,600 | Yarrow Water-tube. |
| Spitfire | 4,500 | Yarrow Water-tube. |
| Starfish | 4,000 | Blechynden Water-tube. |
| Sturgeon | 4,000 | Blechynden Water-tube. |
| Teazer | 4,800 | White Water-tube. |
| Thistle | 1,300 | Yarrow Water-tube. |
| Thrush | 1,200 | Cylindrical. |
| Tyne | 1,800 | Cylindrical. |
| Vestal | 1,400 | Belleville Water-tube. |
| Wizard | 4,800 | White Water-tube. |
| Wye | 1,050 | Cylindrical. |
| Zebra | 4,800 | White Water-tube. |
| Zephy | 3,850 | Reed Water-tube. |

(12) "*Two claims have been put forward, and I think it is the duty of those who speak on behalf of the engineers to reconcile these views. There is a claim for more promotion and a claim for an increased number of engineers.—There is no compatibility about those two propositions.*"

The two claims are perfectly compatible and will be readily understood by those who are in any way familiar with the conditions. The increase which has taken place in the number of vessels of H.M. Navy necessitates a corresponding increase in the number of engineer officers. Instead of creating a sufficient number of chief engineers by promoting them at about 28 to 30 years of age, as is the case with lieutenants and paymasters, the Admiralty promote them at about 38 but appoint them as officers "in lieu of chief" many years earlier without giving them the nominal rank or pay of the position which the duti demand.

TABLE II.—SHIPS IN H.M. NAVY IN WHICH ENGINEER OFFICERS BELOW THE RANK OF CHIEF ENGINEER ARE "BORNE IN LIEU OF" CHIEF ENGINEERS, WITHOUT RECEIVING THE RANK OR PAY OF CHIEF ENGINEERS. *This has no parallel in any other Branch of the Service.*

| Name of Ship. | I.H.P. | Type of Boilers. |
|---|---|---|
| Alacrity | 3,000 | Cylindrical. |
| Antelope | 3,500 | Cylindrical. |
| Ardent | 4,300 | Thornycroft Water-tube. |
| Barracouta | 3,000 | Cylindrical. |
| Bat | 5,900 | Reed Water-tube. |
| Beagle | 2,000 | Cylindrical. |
| Bittern | 6,300 | Thornycroft Water-tube. |
| Black Prince | 6,000 | Cylindrical. |
| Blanche | 3,000 | Normand Water-tube. |
| Boxer | 4,300 | Thornycroft Water-tube. |
| Bruiser | 4,300 | Thornycroft Water-tube. |
| Bullfinch | 5,800 | Yarrow Water-tube. |
| Buzzard | 2,000 | Cylindrical. |
| Calliope | 4,000 | Cylindrical. |
| Calypso | 4,000 | Cylindrical. |
| Cheerful | 6,100 | Thornycroft Water-tube. |
| Conflict | 4,800 | White Water-tube. |
| Coquette | 5,700 | Thornycroft Water-tube. |
| Crane | 5,900 | Reed Water-tube. |
| Desperate | 5,700 | Thornycroft Water-tube. |
| Dove | 5,800 | Yarrow Water-tube. |
| Electra | 5,800 | Normand Water-tube. |
| Express | 9,250 | Normand Water-tube. |
| Falcon | 6,250 | Thornycroft Water-tube. |
| Fame | 5,700 | Thornycroft Water-tube. |
| Fawn | 6,200 | Reed Water-tube. |
| Foam | 5,700 | Thornycroft Water-tube. |
| Hart | 4,000 | Thornycroft Water-tube. |
| Hasty | 3,700 | Yarrow Water-tube. |
| Janus | 3,900 | Reed Water-tube. |
| Jason | 3,500 | Cylindrical. |
| Kestrel | 5,800 | Normand Water-tube. |
| Lee | 6,000 | Yarrow Water-tube. |
| Leven | 6,300 | Thornycroft Water-tube. |
| Onyx | 3,500 | Cylindrical. |
| Orwell | 6,300 | Normand Water-tube. |
| Otter | 6,300 | Thornycroft Water-tube. |
| Recruit | 5,800 | Normand Water-tube. |
| Renard | 3,500 | Cylindrical. |



It has been suggested that the Admiralty will now meet the recommendation of the Institutions that this grossly unjust system should be abolished, by simply omitting the words " in lieu of " and making these ships appointments for officers of rank junior to chief engineers. It may safely be assumed, however, that the Admiralty would not adopt such a course, especially as the title " in lieu of chief " implies increased responsibility.

TABLE III.—SHIPS IN H.M. NAVY IN WHICH ENGINEER OFFICERS BELOW THE RANK OF CHIEF ENGINEER ARE IN SOLE CHARGE OF THE MACHINERY, BUT ARE NOT STATED IN NAVY LIST TO BE " IN LIEU OF CHIEF ENGINEERS."

| Name of Ship. | I.H.P. | Type of Boilers. |
|---|---|---|
| Alarm | 3,500 | Cylindrical. |
| Albatross | 7,500 | Thornycroft Water-tube. |
| Alberta | 1,500 | Cylindrical. |
| Algerine | 1,400 | Cylindrical. |
| Angler | 5,700 | Thornycroft Water-tube. |
| Arab | 8,600 | Normand Water-tube. |
| Ariel | 5,700 | Thornycroft Water-tube. |
| Avon | 6,000 | Thornycroft Water-tube. |
| Banshee | 4,400 | Normand Water-tube. |
| Brazen | 5,800 | Normand Water-tube. |
| Charger | 3,100 | Yarrow Water-tube. |
| Chamois | 6,200 | Reed Water-tube. |
| Champion | 3,000 | Cylindrical. |
| Cleopatra | 3,000 | Cylindrical. |
| Cygnet | 5,700 | Thornycroft Water-tube. |
| Cynthia | 5,700 | Thornycroft Water-tube. |
| Dasher | 3,800 | Yarrow Water-tube. |
| Dragon | 4,400 | Normand Water-tube. |
| Dryad | 3,500 | Locomotive. |
| Earnest | 6,300 | Normand Water-tube. |
| Fairy | 6,300 | Thornycroft Water-tube. |
| Fearless | 3,200 | Cylindrical. |
| Flying Fish | 6,200 | Reed Water-tube. |
| Gipsy | 6,300 | Thornycroft Water-tube. |
| Gleaner | 3,500 | Locomotive. |
| Goldfinch | 1,200 | Cylindrical. |
| Gossamer | 3,500 | Reed Water-tube. |
| Greyhound | 6,000 | Yarrow Water-tube. |
| Griffon | 6,300 | Normand Water-tube. |
| Harrier | 3,500 | Locomotive. |
| Hazard | 3,500 | Locomotive. |
| Hearty | 3,150 | Cylindrical. |
| Hussar | 3,500 | Locomotive. |
| Icarus | 1,200 | Cylindrical. |
| Jaseur | 3,500 | Locomotive. |
| Kangaroo | 6,100 | Reed Water-tube. |
| Leda | 3,500 | Locomotive. |
| Leopard | 6,300 | Thornycroft Water-tube. |
| Lively | 6,250 | Normand Water-tube. |
| Mallard | 5,700 | Thornycroft Water-tube. |
| Mermaid | 6,100 | Thornycroft Water-tube. |
| Myrmidon | 6,200 | Reed Water-tube. |
| Osprey | 6,300 | Thornycroft Water-tube. |

TABLE III.—*Continued.*

| Name of Ship. | I.H.P. | Type of Boilers. |
|---|---|---|
| Ostrich ... | 6,250 | Thornycroft Water-tube. |
| Panther .. ... | 6,300 | Normand Water-tube. |
| Peacock ... ... | 1,800 | Cylindrical. |
| Peterel ... ... | 6,200 | Normand Water-tube. |
| Phœnix ... .. | 1,400 | Cylindrical. |
| Pigeon ... ... | 1,200 | Cylindrical. |
| Pigmy ... ... | 1,200 | Cylindrical. |
| Plassy ... ... | 3,500 | Locomotive. |
| Plover ... ... | 1,200 | Cylindrical. |
| Quail ... . | 6,3 0 | Normand Water-tube. |
| Racehorse ... ... | 6,000 | Yarrow Water-tube. |
| Racer .. . | 850 | Cylindrical. |
| Raven ... ... | 540 | Cylindrical. |
| Redpole ... ... | 1,200 | Cylindrical. |
| Research ... ... | 675 | Cylindrical. |
| Roebuck ... ... | 6,000 | Yarrow Water-tube. |
| Skipjack . .. | 6,300 | Reed Water-tube. |
| Spanker .. ... | 3,500 | Tu Temple Water-tube. |
| Sparrow ... ... | 1,200 | (Assistant Engineer in sole charge). |
| Sprightly ... ... | 6,250 | Normand Water-tube (Laird). |
| Success ... ... | 6,000 | Thornycroft Water-tube. |
| Surly ... ... | 4,100 | Normand Water-tube. |
| Sylvia ... ... | 6,300 | Yarrow Water-tube. |
| Taku ... ... | 6,000 | (Assistant Engineer in sole charge). |
| Thorn ... ... | 6,400 | Normand Water-tube. |
| Thrasher ... ... | 6,500 | Normand Water-tube. |
| Tiger ... ... | 6,400 | Normand Water-tube. |
| Torch ... ... | 1,400 | Cylindrical. |
| Victoria and Albert | 2,400 | Cylindrical. |
| Vigilant ... ... | 6,400 | Normand Water-tube. |
| Vixen ... ... | 6,000 | "Express" Water-tube. |
| Whiting ... ... | 5,900 | Reed Water-tube. |

(13) "*I have not heard it suggested that engineers should under any circumstances take command of ships.*"

It has never yet been suggested either by the engineering institutions, or by the engineer officers themselves, that the

Then as regards power of punishment for delinquencies committed by stokers in the engine and boiler-rooms. Why should not chief engineers have the same power of minor punishment allowed them as a commander, second-in-command, a first lieutenant, or, to quote an analogous case, a captain of marines, for military offences, under the same restrictions as quarter-deck investigations, etc.? If this were permitted it would tend largely to improve the chief engineer's position and strengthen his authority.

It is just this *strengthening of the authority* of the engineer officers which is the keystone of the position, as it will undoubtedly result in greater efficiency and be of inestimable value in actual warfare.

(15) "*My own view is that it is a lamentable thing that the engineer officers should feel impelled to look outside the Navy for their future, and the fulfilment of their ambition.*"

The Engineering Institutions hold no brief on behalf of the engineer officers. If Mr. Arnold Forster intends to insinuate that the Institutions are investigating the subject of "Naval engineers and naval efficiency," on behalf of the engineer officers, then his insinuation has no foundation in fact; the basis is national, not individual.

(16) "*There is only one trades union that is good for the Navy, and that is the Navy itself.*"

It is regrettable that the Secretary of the Admiralty should have confused scientific societies with trades unions. The professional engineers who are investigating this question have the efficiency of H.M. Navy at heart to an extent quite equal to Mr. Arnold Forster, and the Board of Admiralty, and they are unquestionably their superiors in their knowledge of marine engineering both as regards materiel and personnel.

(17) "*These men (engineer officers) should feel that they have a part in the traditions of the Navy.*"

This is impossible as long as the repression of their branch is persisted in. The methods of the Admiralty have brought engineering in the Navy into such disrepute that after 3 months' advertisement, no candidates for engineer officers presented themselves at the January examination. To thus trifle with Imperial interests is nothing short of a national crime, and the first naval war that this country is engaged in will prove the truth of this strong assertion.

(18) "*I think the Admiralty would be on right lines in encouraging this feeling amongst engineer officers that they are a part of the Navy, and making them feel that there is a future for them there, and that they need not look to any other source. For that reason I deprecate any suggestion that another corps should be formed; it is unnecessary.*"

It is simply a calamity that the Admiralty persist in refusing to differentiate between engineer officers as individuals and engineer officers as factors in naval efficiency. Rank, pay, promotion, etc., are simply means to an end, and that end is efficiency in the engineer branch of H.M. Navy. It is the engineer branch which, in actual warfare, will have a determining influence on naval success. Mr. Arnold Forster's argument is apparently based on the plane of the individual, but that of the Institutions is based on the higher plane of naval efficiency, and, therefore, of the nation.

(19) "*The case has recently been put before the public in a manner which I know has been present to the mind of many members, and though it may have been a useful contribution to the solution of the controversy, it is not the most valuable contribution that could be made. There are highly coloured statements and exaggerations in it.*"

The following letter was addressed to Mr. J. A. Bedbrook, R.N., Chief Inspector of Machinery (Retired), and Mr. C. M. Johnson, R.N., Chief Inspector of Machinery (Retired):—

HARTLEPOOL ENGINE WORKS, HARTLEPOOL,
March 5th, 1902.

Dear Sir,

[redacted]

(Copy.)

HARESFIELD, BLENKARNE ROAD, S.W.,
6th March, 1902.

D. B. Morison, Esq.,

Dear Sir,

In reply to your letter of the 4th inst., *re* your paper, which was read before the North-East Coast Institution of Engineers and Shipbuilders, I beg to say that I have carefully re-read the paper, and I find no exaggerations or inaccuracies in it; the paper consists largely of plain statements of facts, the comments made and opinions expressed being moderate in tone and fully borne out by the facts mentioned. There are certainly sufficient facts brought forward to make a highly coloured picture of the unsatisfactory state of the engineering branch of the navy, but the case is already so strong that there is no need of any embellishment to make members of the engineering profession understand the exact condition of affairs.

You are at liberty to make what use you please of this letter.

I am, yours very truly,
J. A. BEDBROOK.

(Copy.)

"RAMENSKOE," MADEIRA ROAD, STREATHAM, S.W.,
8th March, 1902.

D. B. Morison, Esq., Vice-President, North East Coast Institution of Engineers and Shipbuilders.

Dear Sir,

Since receiving your letter of 5th inst., I have carefully re-read your paper submitted to the North-East Coast Institution of Engineers and Shipbuilders on the 7th February last, with the express intention of detecting any possible inaccuracies or exaggerations which might have crept into its pages, through misunderstanding on your part, or from incorrect information supplied in all good faith, but nevertheless erroneous. I am bound to say that the most careful examination of its pages has failed to reveal any single statement or deduction which errs on the side of exaggeration. In fact, I am of opinion that seeing the mass of information you must have collected, and the evident sympathy with which you have carried your work to completion, you have exercised a strong self-control, where there must have been great temptation to deepen the colours though ever so little.

Speaking from the experience gained in the Navy as a sea-going engineer of nearly thirty-eight years continual service, I am satisfied that no abler contribution to the literature which the engineer question has produced during the past forty years, has ever issued from the press, than this of which I am writing. The line of action foreshadowed by your Institution cannot but be productive of good results in the interests of the country at large, and of the Navy in particular, if the taxpayers will only rouse up from their lethargy, and take an active interest in a subject which involves the safety of the national policy of insurance.

Thanking you for the very great personal interest you have displayed with reference to the naval engineer question, and with a sincere hope that your efforts may be productive of good from the national point of view,

I am, dear sir, yours faithfully,
CHAS. M. JOHNSON.

(20) "*I find a table set out for the information, not of the people informed upon the subject, but of the general public, purporting to give the increase in horsepower in the Navy, and the corresponding increase in the engineering staff, and the moral is drawn that the increase in personnel is wholly inadequate.*"

The table is correct in every particular and unfortunately for the British Navy the moral is also only too true.

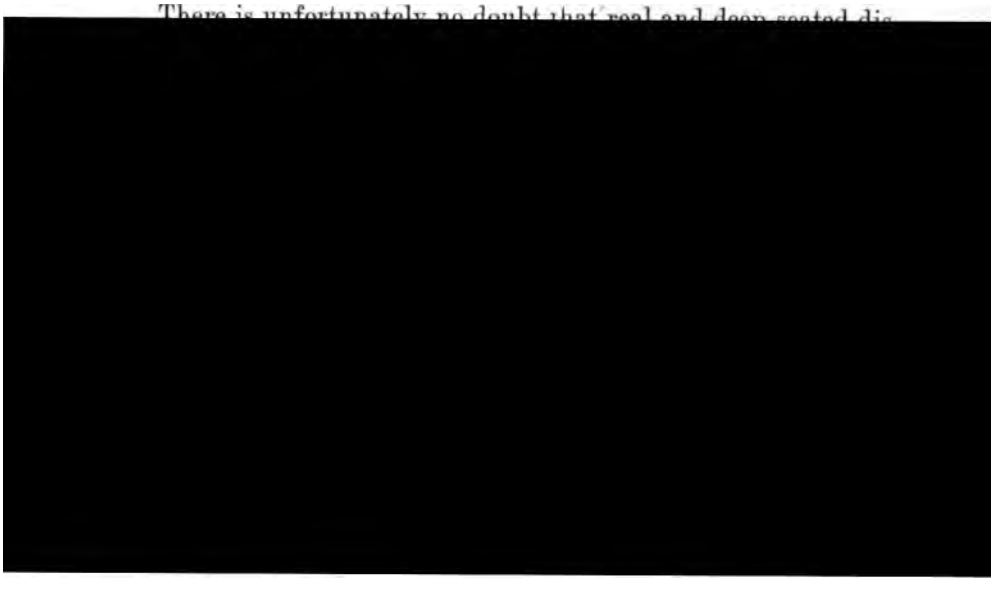
(21) "*But is it not rather an unreasonable thing that in this connection no mention should be made of the fact that during the time this increase had been going on nearly* 4,000 *engine-room artificers had been added.*"

In Appendix A, page 125 of the paper to which Mr. Arnold Forster refers, the number of artificers is not only mentioned, but it is contended that the number is inadequate. A complete table giving the numbers of artificers from 1878 to 1900 is also clearly set forth on page 4 of the paper I submitted to the North-East Coast Institution in 1900.

(22) "*It is most important that there should be no justification for a feeling of discontent in this branch of the Royal Navy. I do not admit that discontent exists.*"

If the Parliamentary Secretary to the Admiralty admitted officially that he knew of discontent in this branch of the public service, it would be his bounden duty as a responsible official to remedy it; if he is not prepared to apply the remedy he will not admit the complaint.

There is unfortunately no doubt that real and deep-seated dis-



The engineer officers of Her Majesty's fleet consider it their duty to make known to all those interested in the efficiency of the Navy, the intense dissatisfaction prevailing amongst them with regard to the unduly subordinate position their department holds in that service.

This dissatisfaction is of long standing, affects all ranks and ratings, and, owing to the development of modern ships of war, leads those officers who are responsible to entertain grave doubts of the ability of their department to bear the stress to which it must be subjected during actual warfare.

It is this discontent which has driven the Admiralty to the adoption of all kinds of unworthy methods in order to attract engineers to the Navy, but without success.

Finally this question was given special prominence in the speeches of the following members of the House of Commons during the recent debate on the Navy Estimates:—

The PARLIAMENTARY SECRETARY TO THE ADMIRALTY (Mr. Arnold Forster).
The EARL OF DALKEITH.
Sir JAS. JOICEY, Bart.
Sir J. COLOMB, K.C.M.G.
Sir J. FORTESCUE FLANNERY.
Colonel DENNY.
Colonel ROPNER.
Mr. W. ALLAN.
Mr. E. M. ARCHDALE.
Mr. JNO. DILLON.
Mr. H. E. DUKE.
Mr. H. E. KEARLEY.
Mr. F. PLATT-HIGGINS.
Mr. JNO. PENN.
Mr. W. PLUMMER.

# ON PASSENGER ACCOMMODATION IN STEAM SHIPS.

By M. C. JAMES, Member of Council.

[Read before the Institution in West Hartlepool on February 22nd, 1902.]

Shipbuilders on the North-East Coast having for so many years been for the most part chiefly concerned in the building of vessels intended almost exclusively for cargo carrying purposes, that it is to be feared such subjects as the arrangement of the passengers' cabin accommodation, and the details of fittings of the cabins themselves, have not received in this district such close and careful attention as they have in those shipbuilding centres which have been more closely identified with the building of passenger steamers. Within the last decade, however, there has been a rapidly growing disposition on the part of many of the leading shipbuilding firms on the North-East Coast to enter more largely into the construction of the best class of passenger steamers, and as a result some magnificent vessels of this type have been turned out of shipyards on the northern shipbuilding rivers. It has, consequently, occurred to the writer that the members of this Institution might with advantage devote some attention to the consideration of the cabin arrangements of passenger vessels and the details in connection therewith, and the present paper has been prepared, not so much with the object of advancing any very novel ideas or proposals on the subject, but rather to review it in such a way as to, if possible, incite a useful discussion on the points involved.

Quite apart, too, from this purely local aspect of the matter, there is, also, the larger and more important national view which has to be borne in mind, more especially considering the very grave fact to which our attention was drawn by the President in the remarks made by him at the recent dinner of the Institution, when he stated that statistics showed that by far the larger number of the passengers crossing the Atlantic are now carried by the German and French lines, whilst only a comparatively small number are patronizing the English boats, and this highly un-

satisfactory state of things has undoubtedly been brought about by the very thorough manner in which the foreign companies cater for the passengers, and to the intelligent and careful attention which they give to the arrangement of cabins, attendance, cuisine, and more particularly to their giving due regard to the most trivial detail which in any way affects the comfort and convenience of the voyagers; modern regular ocean travellers, especially Americans, being most exacting in their requirements. The forward line of action adopted by the foreign lines stands in marked contrast to the conservatism, indifference and neglect characteristic of many of the leading British passenger lines.

From the earliest ages there has been constructed on shipboard accommodation of one kind or other for those navigating or working the vessel, and rooms or cabins have been provided in special cases for those simply journeying on the ship. Such accommodation, as far as we know, was generally of a severely plain and simple character, though in some ships of the ancients very luxurious quarters seem to have been fitted, such, for instance, as those referred to by Athenius in his description of that marvellous, if somewhat mythical, vessel said to have been built by Archimedes about 250 years B.C. This craft is reputed to have had on the middle deck 30 rooms, in each of which were four beds, and there were besides baths, gardens, a library, and many other conveniences too numerous to mention. The decorations, too, were extremely elaborate, the stanchions supporting the upper deck represented statues of Atlas, and the ceilings represented the star spangled heavens.

Cabins were first introduced into English ships about the middle of the 13th century, and in the year 1242 orders were given that "decent chambers" were to be constructed in a ship

given to the accommodation for the passengers, for in the year 1838 we find the advertisement of the first voyage of a new Atlantic steamer, stating, among other advantages, that her accommodation was "capacious and well arranged for comfort;" later on in the same year another new Atlantic steamer is described as having state-rooms "exceedingly handsome and commodious, each having two berths or beds, except two rooms, which are fitted for the peculiar accommodation of a party, with three beds." There was also some attempt at artistic decoration, for the description states "the colouring of these rooms is a warm delicate pink, with gorgeous damask silk hangings to correspond, of French white, with crimson satin stripes."

Notwithstanding these improvements, a trip across the Atlantic in a steamer at that period does not seem to have been a very comfortable journey, for we find that great author, the late Mr. Charles Dickens, writing from New York in 1842 to his friend John Foster in London, as follows: "We mean to return home in a packet-ship, not in a steamer. Were I to tell you all that I observed on board the 'Britannia' you would not wonder at my determination never to trust myself upon the ocean in a steamer again."

In 1850 important advances appear to have been made, for in a description of a new Atlantic steamer completed in that year it is stated "two of the state-rooms for first-class passengers have four berths in each, all the others have only two," and the description of the passenger accommodation is summed up with the statement that "nothing has been left undone which science and ingenuity can suggest to add to the comfort and convenience of the passengers."

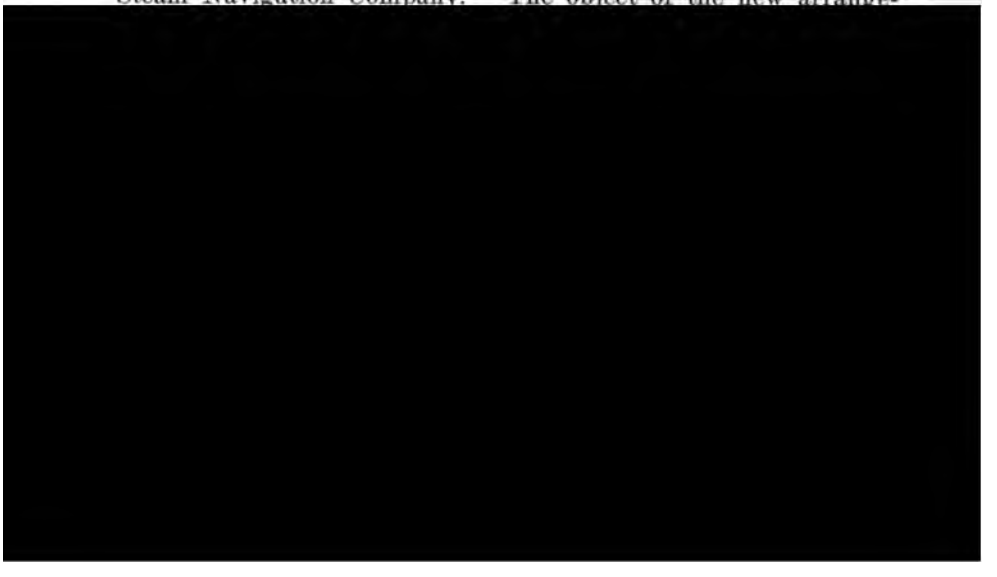
Another important improvement was announced in 1871, when the White Star Line advertised steamers whose "State-rooms with saloon and smoking rooms are placed amidships, and cabin passengers are thus removed from the noise and motion experienced at the after part of the vessel."

During the last 20 years considerable changes, mostly for the better, have been introduced into the arrangement of the passenger accommodation, chiefly with respect to the dimensions and positions of the state-rooms and saloons, the grouping of the rooms, number of beds, and to numerous details of the cabin and other fittings.

As to the situation of the quarters for the different classes of passengers the old plan was to place the first-class accommodation aft, generally in a poop, the saloon being in the centre, with the state-rooms next to the ship's sides, and leading directly off the saloon. In well arranged modern passenger boats the first-class rooms are located amidships, the second-class cabins are placed aft in the poop, and the third-class or emigrants' quarters either right forward or in the after 'tween decks, the latter being in certain services a very satisfactory arrangement on sanitary and other grounds. The first-class dining saloon is now invariably placed amidships, this arrangement having been first introduced in the White Star s.s. Oceanic in 1871.

With respect to the grouping of the state-rooms the old plan of having an uncomfortable stuffy saloon over the propeller, flanked by rooms on either side and leading directly off it, as shown in Fig. 1, Plate XV., was very objectionable for many obvious reasons, and this in time gave place to an arrangement such as is shown in Fig. 2, Plate XV., where the rooms are placed with alleyways between, from which they are entered. This arrangement gives much better ventilation and light, and in ships of large beam the rooms stand in blocks of four, as shown in Fig. 3, Plate XV., the inner rooms depending for light and ventilation from hipped skylights fitted in the sides of deck houses and casings. These inner rooms have not been popular in long voyage services, and especially in warm climates, on account of their indifferent light and their general stuffiness.

A new arrangement of tandem state-rooms has recently been patented by Mr. A. W. Bibby, of Liverpool, a gentleman who is prominently identified with the Bibby Line and the Pacific Steam Navigation Company. The object of the new arrange-



arranging certain cabins "en suite" for the convenience of families, and nowadays a much larger number of single-berthed rooms are fitted than was formerly the practice. A noticeable feature, too, is the great improvement in the general get-up and arrangement of the second and third-class quarters. In many of the leading liners the second-class cabins are so well fitted as to be nearly equal to the first-class, whilst the modern third-class quarters are frequently quite equal to, if not better than, the first class cabins were in many of the older ships. A prominent example of this is to be found in the third-class accommodation as fitted in the Tyne-built Cunard liner "Ivernia." (See Fig. 7, Plate XVIII.).

Complaints have frequently been made that far too much attention is given to the arrangement of the saloons, smoke room, social halls, library, etc., and excessive expenditure lavished on their furnishings and decorations. It has been advanced that this might with advantage be curtailed, and the money be more usefully and effectively spent on the state-rooms, the absurdity of luxuriating in a palatial saloon during the day only to retire to a cramped-up, dark and indifferently ventilated state-room at night being only too apparent. Besides, passengers in the throes of *mal-de-mer* have perforce to spend more of their time in their cabins than in the saloons, and high art decorations, though possibly things of beauty, yield but little joy or comfort to the sea-sick passenger.

The writer having for some years been actively concerned in the designing of cabin accommodation and in the arranging of state-room fittings, etc., as well as having himself voyaged in the vessels of some of the leading passenger lines, spent some restless nights and gasped for air in some of their state-rooms, as the result of his observations and experience would submit the following points as being deserving of very special attention and consideration:—

Height of 'tween decks: this in the old passenger boats was too restricted, in most modern ships it has been considerably increased, giving greater cubic capacity to the rooms and adding enormously to the comfort of the occupants. Size of state-rooms: even yet rooms are frequently much too cramped, rendering the operation of getting into or out of bed extremely risky, the passenger either barks his knees or ankles, or a portion of the scalp

is removed from his head. The writer was much struck when looking over an Italian passenger steamer in Genoa, where she was built and engined, to note the great length of the state-rooms; they were quite two feet longer than ordinary English practice, and the rooms were thereby much more commodious. Number of beds in each room: as has been pointed out already, a much larger number of single-bedded rooms are now provided in the best ships; these are a great boon, particularly where passengers are picked up at intermediate ports, and the passenger who was put into a double-bedded room at the first port of departure has an unexpected, and to him unknown and perhaps highly objectionable, berth companion thrust into his room at the first port of call. This is a standing grievance in the South American passenger service. An ingenious arrangement of single-berthed room, though somewhat cramped, is shown in Fig. 8, Plate XVIII.; it has been adopted in some Atlantic liners.

Regarding the details of the room fittings: wood linings over ironwork, and elaborate wood fittings introduced for mere appearance sake, should be reduced to an absolute minimum. The space between the lining and the ship's side or the deck becomes a lodging place for foul air and vermin, and largely contributes to the peculiar closeness so often experienced in state-rooms. The bulkheads forming the sides and ends of the room should be quite flat and plain, not panelled. Venetian framing is undesirable, it gives but little ventilation, and forms a lodgment for dust, dirt and vermin. Natural ventilation is best obtained through gratings in the doors and framing, and by leaving the framing short by depth of the beam, the space having a perforated metal filling to prevent rats, etc., getting through. No permanently fixed

seats should fold up to facilitate the washing and sweeping out of the room, and no floorcloth should be laid on the floor; the deck planks should be simply planed, scrubbed white and clean, and a loose rug overlaid.

Quickly-shutting pivoted ports of large diameter should be fitted to each room, and in addition to curtains, there should be venetian shutters to keep out brilliant sunshine. Folding wash-stands have proved a great convenience, and they economise space, but where there is more than one bed in a room the wash-stand should be double, and their fronts should be fitted so as to fold down and form little tables. The need of the latter is much felt in most state-rooms. Wardrobes are usually much too small; they should be quite twice the usual size, so, too, should the chests of drawers. Careful attention ought to be given to the numerous smaller fittings, such as folding racks, ajar hooks, hat and coat hooks, watch pockets, etc. They should be fitted in sufficient quantities, and in well selected positions. The pushes for the call bells and the electric light switches should, also, be placed in the most convenient positions, and the best location for the electric light itself ought to be duly considered. In many instances the racks for lifebelts are fixed in awkward situations above the beds, thus taking away the headroom, or sometimes the lifebelts are stowed under the beds, they are not then readily accessible in time of need; the most compact and convenient arrangement is to dispense with the ordinary cork lifebelts, and supply instead combined bolster lifebelts stuffed with reindeer hair, these can be placed under the pillow in each bed, and no racks are then necessary.

There are many other important points which the writer would have liked to have touched upon, but he fears he has already gone beyond the limits of length of an ordinary paper. Some of these points would indeed require separate papers to do them anything like justice. The questions of electric fittings, lighting, and ventilation have already been ably and fully dealt with in papers read before the Institution. As to the warming arrangements usually employed, the writer considers steam heating for cabins an abomination, and it is an endless source of worry and expense. A simple yet effective system of warming by means of heated air has yet to be devised.

The sanitary arrangements of a passenger ship is an intricate question which the writer trusts some member will deal with in

a special paper. So, too, is the large and interesting subject of the decorative treatment of saloons and cabins. Our Council has already suggested these as suitable subjects for papers, and it is to be hoped they will soon be forthcoming.

In conclusion the writer craves the indulgence of the members for the very incomplete manner in which the subject of passenger accommodation has been treated in this paper. He trusts, however, it may serve the purpose of opening out the subject for discussion, and draw forth some interesting and valuable contributions to the *Transactions*.

The PRESIDENT said—Mr. James, in his paper, refers to some remarks I made at the annual dinner. The statement that I saw in one of the newspapers showed something like 21,000 passengers carried by the Hamburg-America line, 21,000 carried by the North German Lloyd, and only 7,000 carried by the White Star line. Since that time I have had an opportunity of inspecting the official statistics of the number of passengers landed at New York by the various steamship lines, and am pleased to find the difference is not so great. The number instead of being 3 to 1 was perhaps 2 or 2½ to 1, yet an explanation throws a good deal of light on the difference. The number of steerage passengers carried by the German lines is enormously in excess of the number carried by the White Star line, and perhaps that is only natural, seeing there is so much emigration from Russia and Germany, and, in fact, all Europe. But taking the number of first and second class passengers carried it is altogether different. The number of first and second class passengers carried by the White Star line is almost exactly the same as the number carried by the Hamburg-America or the North German Lloyd lines, although the sailings of the two latter lines greatly exceed the White Star sailings. Again, taking the first and second class, the average number of passengers carried out and home by the White Star line is 163 per trip, the average for the North German Lloyd is 115 per trip, and the average for the Hamburg-America line 116 per trip. These figures show that the White Star line is still a very popular one for this class of passengers.

The discussion was adjourned until the next general meeting.

The meeting then dissolved.

# NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

EIGHTEENTH SESSION, 1901-1902.

## PROCEEDINGS.

### FIFTH GENERAL MEETING OF THE SESSION, HELD IN THE MARINE SCHOOL, OCEAN ROAD, SOUTH SHIELDS, ON FRIDAY EVENING, MARCH 21ST, 1902.

ALD. JOSEPH M. RENNOLDSON, J P., VICE-PRESIDENT, IN THE CHAIR.

The VICE-PRESIDENT said—I regret that the President, Mr. Withy, is absent in London and cannot be with us to-night. I am sure we would have been very pleased if he had been able to visit South Shields.

The SECRETARY read the minutes of the Fourth General Meeting held at West Hartlepool, on the 22nd February, 1902, which were approved by the members present and signed by the Vice-President.

The ballot for new members having been taken, the Vice-President appointed Mr. George Donkin, jun., and Mr. William Paulin to examine the voting papers, and the following gentlemen were declared elected:—

MEMBERS.

**Fairbairn, Archbold**, Engineer. Violet Street, South Hylton, Sunderland.

**Findlay, John Taylor**, Ship Surveyor. Lloyds Register, 3, St. Nicholas' Buildings, Newcastle-upon-Tyne.

**Geddes, Frank**, Engineer, The Grove, Shotley Bridge, Co. Durham.

**Latta, James G.**, Consulting Engineer, 78, Billiter Buildings, Billiter Street, London, E.C.

Macfarlane, Archibald P., Supt. Engineer, 15, Beacon Street, Low Fell, Gateshead-on-Tyne.

Peat, Herbert, Engineer Inspector, 12, Cheltenham Terrace, Heaton, Newcastle-upon-Tyne.

Snell, John F. C., Electrical Engineer, Borough Electrical Engineer, Town Hall, Sunderland.

GRADUATE TO MEMBER.

Danielsen, John William, Engineer, Highfield, Farquhar Road, Birmingham.

ASSOCIATES.

Harris, John T., Accountant, Messrs. Irvine's Shipbuilding Co., Ltd., West Hartlepool.

Taylor, Edward, Manufacturer, Tyneside Works, Scotswood-on-Tyne.

Taylor, Swainson T., Manufacturer, Tyneside Works, Scotswood-on-Tyne.

GRADUATES.

Anderson, Thomas C., App. Engineer, Bigges Main House, Wallsend-on-Tyne.

Tulip, Wilfred, Engineer Draughtsman, Whinney Hill, Choppington, Morpeth.

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## PRESENTATION.

The VICE-PRESIDENT presented Mr. Edwin Griffith with the engineering gold medal awarded to him for his paper on "Water Tube Boilers" read before the Institution last session.

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The discussion on Mr. E. C. Chaston's paper on "The Ballasting of Modern Tramp Steamers" was resumed.

## RESUMED DISCUSSION ON MR. E. C. CHASTON'S PAPER ON "THE BALLASTING OF MODERN TRAMP STEAMERS."

The SECRETARY read the following communication:—

BEECHCROFT, CLIFTON AVENUE,
WEST HARTLEPOOL,
*20th March*, 1902.

DEAR MR. DUCKITT,

As I cannot be present at the meeting to-morrow I beg to offer the following remarks on Mr. Chaston's paper:—The subject of it, "Ballasting of Modern Tramp Steamers," is receiving more attention now than it did a few years ago. It is now generally acknowledged that insufficient ballasting has a lot to do with the breaking of shafts, propellers and steam pipes, and straining of machinery. Owners fully realise this, and are making enquiries as to how best to get sufficient water ballast capacity in new ships.

The examples given in Mr. Chaston's paper show that modern cargo steamers of 5,700 tons deadweight capacity with only the ordinary provision for water ballast are not seaworthy without additional weight in them. They also show that 500 tons to 750 tons of additional ballast judiciously placed on board of such vessels makes them seaworthy and enables them to voyage in ballast with the certainty of not being driven out of their course by stormy weather, and also of reducing the risk of straining the machinery.

Some authorities have advocated a very large increase of ballast capacity, which would add considerably to the cost of vessels, but the examples given by Mr. Chaston, and borne out by experience with other ships, show that safety is ensured by a moderate increase of ballast.

During the recent storms, and since Mr. Chaston's paper was written, two steamers stranded on the north-east co

at the Board of Trade enquiry in each case the vessels were pronounced to be unseaworthy by reason of their not having had sufficient ballast on board, and the captains were held responsible. Now it is manifestly unfair that captains should be held responsible for taking ships to sea insufficiently ballasted when there is no regular standard of draft of water or other measure to guide them as to what is sufficient ballasting. And it does not seem honest on the part of the Board of Trade to prosecute captains for the insufficient ballasting of their ships when even the courts which are called upon to adjudicate have no standard to guide them in arriving at their decisions.

It is no doubt of advantage that enquiries should be held into the causes of the stranding of ships and that the facts should be ascertained in cases of insufficient ballasting, for the guidance of the Board of Trade in framing regulations.

Some progress might be made in the matter if the Board of Trade were to get a committee appointed consisting of shipowners, shipbuilders, underwriters, register societies and others to formulate and recommend a general underload line scale which need not be compulsory, but could be tried and revised afterwards, if experience showed that to be necessary, before being finally adopted.

Captains would then have a guide to the ballasting of their ships, and in building new vessels owners could, if they desired, stipulate for sufficient water ballast capacity in case they wished to be free from the necessity of shipping rubbish ballast. The courts also would have a recognized standard by which to try cases of alleged under-ballasting and some show of reason in finding owners and captains responsible if their disregarding such a standard resulted in loss of life or property.

## MR. E. C. CHASTON'S REPLY.

Mr. E. C. CHASTON replied to the discussion. He said:—Before directly replying to the discussion, I take the liberty of deviating somewhat, by putting before the members the Plates numbered XIX. and XX. Fig. 5 (Plate XIX.) shews the ballast trim water line AA of the present type of cargo steamer as originally designed, with a double bottom water ballast capacity of about 813 tons. The ballast trim water line BB shews the trim with about 780 tons additional water ballast in 'tween deck tanks. Fig. 6 (Plate XIX.) is supplemental to Fig. 5, and shews the drafts through the three mid-ships sections under the conditions as before stated. This diagram fully demonstrates the helpless and dangerous conditions under which a vessel is placed on a lee shore with a light load draft as shewn on water line AA, and the huge freeboard exposed to the full force of a gale. Plate XX. shews the general arrangement of 'tween deck ballast tanks, and is only put before the members of the Institution in the hope that it may be of some use to them.

Regarding Mr. Withy's remarks as to the number of ships stated in my paper as having come to grief through want of ballast (see pages 59 and 60), I have looked carefully into the cases of the 39 steamers on the list, and the nature of their trades, and have come to the conclusion that at least 22 of the 39 mishaps can be traced to want of sufficient ballast. It is quite a common thing for a vessel of 5,000 to 7,000 tons to be threshing away across the Atlantic for from 16 to 19 days in ballast and arrive at her destination safely, take her cargo, sail homeward and lose her propeller, etc., or break her shaft before she gets across the Atlantic again. Although the vessel is loaded at the time of the mishap, it can safely be assumed that the defects developed when the vessel was outward bound in ballast. This is common knowledge among superintendents and marine surveyors. In further proof of this theory it is a remarkable fact that oil boats seldom have shaft breakages, etc.

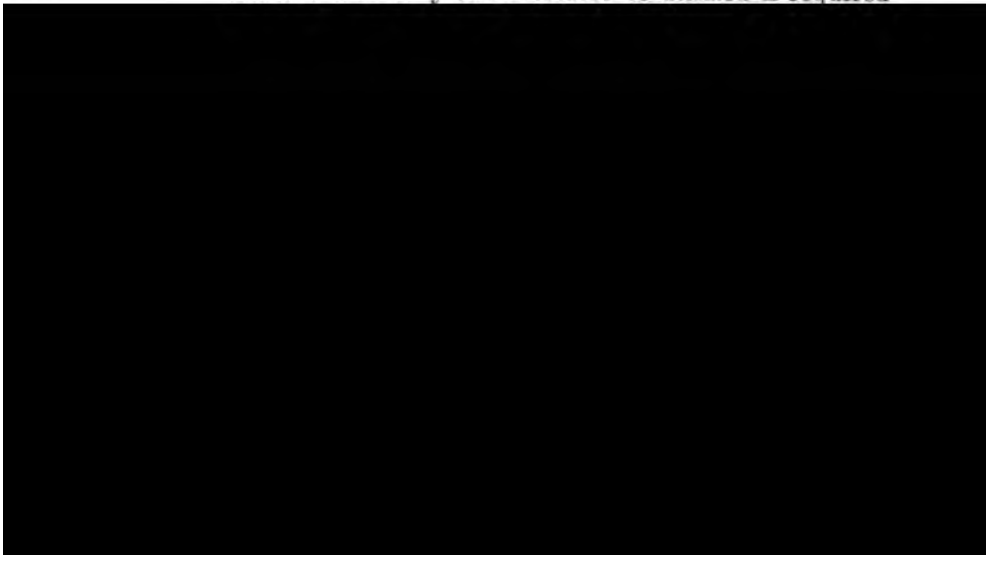
With reference to Captain Lord being in favour of the deep tank, I may say that in my paper I did not advocate any special means of extra ballasting, but I have recently gone very closely into the matter as to what is the best type of ballast tank. No

doubt the deep tank is the simplest and perhaps the cheapest type, but so far as I can find, the following are its objectionable features:—

(*a*) Liability to have leaky bulkheads.
(*b*) Necessity of having small hatches into one of the principal holds.
(*c*) Difficulty of cleaning and drying as compared with 'tween deck tanks.
(*d*) Loss in stowage if longitudinal divisions are fitted, increased comparative cost, and additional weight of material.
(*e*) The ship is not so easy in a sea-way.

The following, to my mind, are the features in favour of 'tween deck tanks:—

(*a*) Weight of water being more longitudinal than vertical, there is less pressure against the bulkhead and consequently less risk of leaking, the 'tween deck beams practically taking the place of bulkhead extra stiffeners. There is less broken stowage in measurement cargo.
(*b*) Size of hatch into lower main hold is not interfered with.
(*c*) Less trouble to clean and dry, due to the fact that they can be cleaned and dried while the vessel is loading in her lower holds.
(*d*) 'Tween deck tanks as shewn in Fig. 7 (Plate XX.) give better trimming facilities than might be necessary when bunkering for any particular voyage, *i.e.*, the approximate 800 tons in two tanks instead of one deep tank; and one tank only can therefore be utilized if required



It is to be regretted that those members of this Institution who have experience with oil tank steamers have not come forward to state their opinions as to the behaviour of that type of vessel in various trims and also to give us some data relating to the low percentage of machinery defects as compared with ordinary tramp steamers.

Since reading my paper, I notice that this question of ballast is receiving more attention from shipowners and their advisers. I therefore hope and expect that Lord Muskerry's proposed Under-load Line Bill will not be necessary. The economic value of having our tramps built as it were to face anything and go anywhere in ballast trim, should be apparent to any one who is interested in the welfare and prosperity of British shipping, without having Bills passed in Parliament to teach interested parties practical common sense.

The proper ballasting of steamers seems to be rather a question of cost than lack of knowledge, and I feel sure that any shipowner who is properly advised will face the cost, knowing that it will eventually be to his own interest, in considerably reducing sea risks, and I believe that it is only then that we shall hear less of the loss of vessels through stranding, long passages and consequent missing of cancelling dates and markets, not to mention time lost in repairing abroad with consequent heavy repair bills, all of which are incidental to the present day type of 6,000 to 7,000 tons tramp steamer.

Regarding Mr. McGlashan's remarks in relation to ballast in side tanks, I carefully read his paper some time ago, and to my mind maintenance when the vessels so fitted have got a little age on them appeared to me to be rather costly. As to the two steamers stranding, in one case the owners were held responsible.

I regret that my reply to the discussion has been somewhat hurriedly drawn up. I therefore crave the indulgence of the members of this Institution towards any weak points which they may detect.

The Vice-President—You have now heard Mr. Chaston's reply. I move that the best thanks of the meeting be given to him for his very able paper. I am sure you will all agree that it is a subject which needs the very closest attention of every one interested in naval architecture.

The motion was carried by hearty acclamation.

## RESUMED DISCUSSION ON MR. F. J. WARBURTON'S PAPER ON "SOME NOTES ON STEAM TURBINES."

The VICE-PRESIDENT—Mr. Warburton's paper is now open for further discussion.

Mr. EDWIN W. DE RUSETT—I should like to ask a question on Mr. Warburton's paper. Would he kindly explain to us how the thrust of the propeller is taken up?

Mr. EDWIN GRIFFITH said—I wish to make a few remarks upon Mr. Warburton's paper, chiefly because I have been associated with him in connection with some tests of the turbine which he has described. I would suggest to Mr. Warburton that perhaps he might be able to give some of the results he has obtained with the experimental turbines. These possibly are not yet in a form that he can give any valuable information of a quantitative character, but he may perhaps be able to state some results of an interesting nature. For example, in a turbine that he tested at Liverpool when I was present we measured the water used for half an hour with the turbine running at about 3,000 or 4,000 revolutions per minute. We then stopped the engine by tightening the brake, leaving all other conditions unaltered, and measured the water used during the next half-hour, which we found to be the same quantity as when the turbine was running. I think that statement is correct.

Mr. WARBURTON—Yes.

Mr. GRIFFITH—I think that is a fact which will interest the meeting; I do not think it is in the paper.

Mr. WARBURTON—No, it is not.

Mr. GRIFFITH—The result I have referred to does not indicate that the turbine was necessarily wasteful, though at first it might appear to do so. I can bear testimony to the quick reversibility of the turbine. In an experiment of a tur-

bine I saw, it was reversed from several thousand revolutions per minute one way to several thousand the other in a few seconds, and it must be very apparent to every engineer that this kind of turbine is a very governable engine, because in varying the position of the reversing lever which admits steam into each compartment you govern at every stage. Supposing there are fifty compartments you govern every one of them instantaneously. So I should say that this turbine is one of the most governable as well as the most reversible engine that has ever been proposed. In this district, just now, there will be an opportunity of comparing the economy of the turbine with the reciprocating engine in rather an interesting way. At the Neptune Power Station there has been working now for a short time a Parsons' turbine of 2,000 I.H.P., and it so happens that there is an ordinary reciprocating engine there of 1,000 I.H.P., installed by the Wallsend Slipway and Engineering Company, in which the bed rock of economy has been reached for such engines. I shall be rather surprised if the economy of the turbine on actual service will come up to that of the engine referred to, especially taking the varying loads into account. It might possibly approach it on a good load. Of course, bearing on that question, the turbine probably will not be used except at a high load, whereas the other engines will be used at more varying loads, that being the most serviceable way of using turbines in conjunction with an ordinary engine. Let the ordinary engine have the low and moderate loads, then put on the turbine for a spurt for a few hours, and knock it off again when the loads go down. I think it is recognized that existing turbines are not economical at low loads, while there is comparatively little difference in the best reciprocating engines from a quarter to full load. I think we are much indebted

much more efficient than the radial form, the reverse side of the curved vanes is about equal in effect to the radial shape. It is possible that the steam current forms vortices in the corners of the cells which, as it were, fill up the spaces, giving much the same effect as if the vanes were straight.

Any reversible steam turbine, however, is bound to be more or less of a compromise according to the nature of the work expected of it, and it is for the designer to decide, in considering his shapes of vanes and dimensions of nozzles, how far this compromise is to be carried out, as it might well be advisable, in the case of a vessel requiring quick manœuvring qualities, to sacrifice a certain amount of steam economy ahead, for rapid and powerful reversibility.

In reply to Mr. P. Mayson Bennett one may perhaps be permitted to congratulate him on the high "mechanical efficiency" of his remarks, for the maximum number of questions is undoubtedly compressed into the minimum amount of space, and I am very much afraid that the time at our disposal will not permit of a full and comprehensive reply to each one.

*Shapes of Orifices.*—I will refer Mr. Bennett to Professor Rankine's book on *Applied Mechanics*, page 579 and following, to be obtained at the North-East Coast Institution library, and also to the works of Napier and Coterill. The subject of the flow of gases through orifices and nozzles is fully examined in these works, and the turbine designer follows these conclusions. Apart from making small allowances for particular cases, the writer has always pinned his faith to the above.

*Theory of Speed of Vanes.*—In a simple impulse turbine, such as shown in Fig. 3 (Plate V.), Dr. Laval has shown years ago that the best speed for the wheel vanes is about 45 per cent., or "just under half" the speed of the steam as stated in the paper. Any standard work on water turbines quotes about the same for Pelton wheels. Rateau, in his *English Patent Specifications*, gives 40 per cent. as best speed, but this is because his moving vanes are to a certain extent helicoidal in arrangement and the whole steam current follows a spiral course down the turbine cylinder in a reverse direction to the rotating shaft.

*Expansion entirely lost in last Impact Turbine described.* Referring Mr. Bennett once again to the Laval turbine, I beg to again quote Dr. Laval's own claims which are justified by the

excellent steam economy obtained by him. This will lead to my point *re* expansion in the last turbine described in the paper. "The function of the steam nozzle is to convert the whole available energy of the steam into mass $X$ velocity in the required direction. It should therefore be designed to expand the steam to the same pressure as that of the wheel chamber before delivery on to the vanes." That is to say, that the whole expansion is accomplished within the fixed nozzle and none whatever between the moving blades. In this connection the equation $PV = \text{constant}$ is useful, together with certain co-efficients according to the particular case. Now it is equally possible to sub-divide this one stage or fall from initial to final head into a number of smaller stages or steps by arranging several Laval wheels in series on one shaft, using only a portion of the head or pressure at each step. This shaft thus collects the total available output of useful work at much fewer R.P.M. for the same diameter wheels. The speed then depends on the number of wheels arranged in series and has obvious practical advantages; it cannot therefore for a moment be maintained that the steam is not expanded just as much in one case as in the other.

*Steam Consumption.*—Some figures are mentioned by Mr. Bennett relating to steam consumptions obtained by Mr. Parsons, but as no particulars are given as regards the conditions of running, sizes and power of machines referred to it is not easy to discuss them. It is of course well known that Mr. Parsons' Elberfeldt machines have given results which compare well with the best reciprocating engines of equal power. It is also becoming generally recognised that steam turbines below say 50 B.H.P. cannot compare in steam consumption with a good reciprocating engine. The future results of the steam turbine

which, when boiled down and licked into shape, will, I hope, form the subject of a further paper to place before the Society.

*Condensing.*—A large increase in efficiency is obtained by condensing, especially at from 24 to 27 inches vacuum, as at these low pressures the steam increases very rapidly in volume.

*Balance.*—The machine illustrated in Fig. 4 (Plate VI.) was found to be almost perfectly balanced endways, and the little differences, if any, were taken up on the bearings.

*Reversing.*—I will refer Mr. Bennett to my reply to Mr. London.

*Floating Packing Rings.*—The leakage past the floating rings was usually about 5 per cent. of the total steam passing through the machine, but this will be improved upon with better workmanship.

*Weight of Floating Packing Rings.*—Mr. Bennett will find, in the North-East Coast Institution library, a contribution to the *Journal of the American Society of Naval Engineers*, vol. ix., 1897, by Professor Albert Kingsbury, entitled, "An Air-lubricated Journal," where the behaviour of a film of steam or other gas between fixed and moving surfaces is very fully discussed, and where it is clearly shown that a film of steam will support a very considerable rotating weight.

*Experimental results.*—In reply to Mr. C. H. Innes—I will refer him to my reply to Mr. Bennett.

*Hydraulic efficiency.*—I quite agree that the ratio of work per pound of steam done on the wheels to that which would be obtained from the steam in an ideal engine working in Rankine's cycle which might, to coin a convenient term, be called the "Rankine ratio," for a steam turbine would undoubtedly be a most useful quantity not only in the design of steam turbines, but also in comparing the various efficiencies of blade forms on which this co-efficient depends.

*Rateau Turbine.*—In reply to Mr. C. J. A. London—The sources of information from which I extracted my observations on these turbines are as follows:—M. Rateau and Messrs. Sautter Harlé of Paris, *English Patent Specifications*, several communications by Prof. Rateau in the leading French technical papers, a descriptive pamphlet and photograph of a 700 K.W. turbo-dynamo which is, I believe, running in their own works, and in this and last week's *Engineer* M. Rateau describes a very inter-

esting turbine-driven fan, which, according to the figures published, is extremely efficient for high air pressures such as are used for cupolas, etc. I have also heard on good authority that a vedette boat in the French Navy is being fitted with these turbines.

*Rapid Reversal.*—The reversing turbine tested by the writer was quite small, giving about 5 B.H.P., and was none the worse for the strain, as the cellular form of wheel is strong and the shaft was of ample dimensions. Moreover, as there were 20 wheels in series and 4 nozzles to each wheel, the steam pressure was very evenly distributed, and when the lever was thrown over, opening the reversal ports, the steam acted as a perfectly elastic cushion, bringing the machine to rest without the slightest shock or injury.

Large marine turbines of course revolve much more slowly, and the writer sees no reason why the mechanism described should not be a convenient and practical means for their control and reversal if due attention is paid to the proper distribution of the steam jets over the revolving discs and to the proportions of the rotating parts.

In reply to Mr. E. W. de Rusett—End thrust might be taken up by an ordinary thrust block or balanced by admitting steam to the space between the sets of large and small floating rings at the ends of the shaft.

*Experimental results.*—In reply to Mr. Edwin Griffith—I will refer Mr. Griffith to my reply to Mr. Bennett under this heading. The rate of steam flow in all steam turbines remains practically constant whether running or held stationary, as described, just as in the case of a water wheel or turbine held

into the question raised, I only have to add that if any of my remarks have succeeded in stimulating some train of thought which might otherwise have lain dormant the purpose of these notes on turbines will have been amply fulfilled.

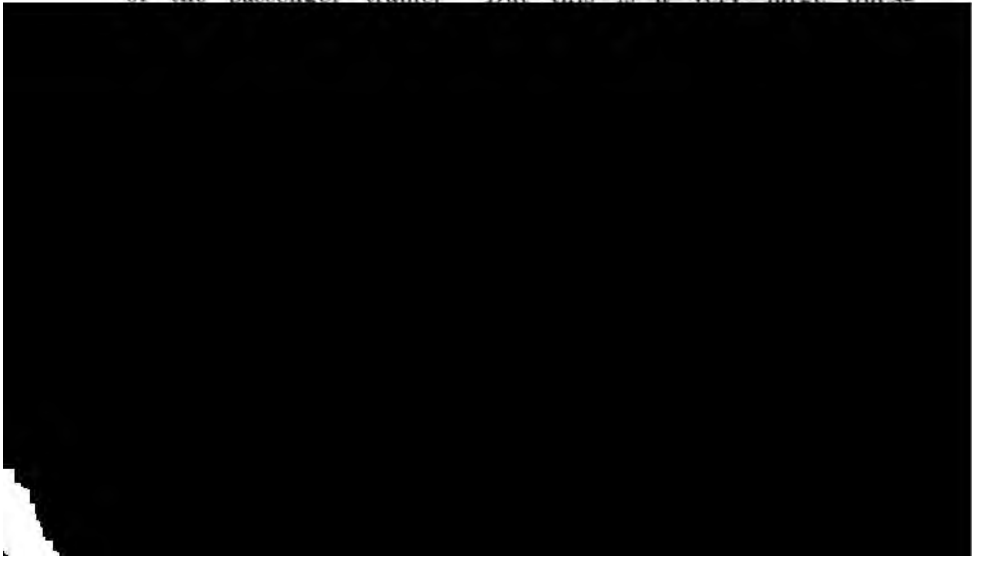
The VICE-PRESIDENT—I have much pleasure in moving that the best thanks of the meeting be given to Mr. Warburton for his excellent paper.

This motion was carried with cordial acclamation.

## DISCUSSION ON MR. M. C. JAMES'S PAPER ON "PASSENGER ACCOMMODATION IN STEAMSHIPS."

Mr. Edwin W. De Rusett said—I have not had the pleasure of hearing the paper read, neither have I heard any remarks which may have been made. Therefore, if in any way I touch on ground that others have already touched upon, possibly you will forgive me. There is one remark in the early part of this admirable paper which I certainly cannot fall in line with. It occurs at the bottom part of the second paragraph, in which the author states: "The forward line of action adopted by the foreign lines stands in marked contrast to the conservatism, indifference, and neglect characteristic of many of the leading British passenger lines." I must at once challenge that word "neglect." Speaking for myself as a British naval architect, I have travelled a great deal in all sorts of liners for the purpose of finding out what passengers really need and what should be done to meet their requirements, and doubtless others in my profession have done the same. Besides, surely neglect can hardly be coupled with the honoured name we have earned as the foremost maritime nation. The history of the development of passenger cabin accommodation is very interesting. No doubt we have learned some interesting facts when reading through the historical portion of the paper. With regard to the various cabins referred to, I am conversant with all of them, but there are some not mentioned, and with your permission I will add one or two illustrations, which although designed some 18 or 20 years ago for vessels of 43 to 44 feet beam may still be of some practical interest (see Plate XXI.). The designs are somewhat similar to the patent berths illustrated in Figs. 4 and 5 (Plate XVI.), as all the berths had side ventilation and side light. Each formed a group of three cabins, with doors opening into a lobby for privacy. In plan A are shewn three cabins, each with two fore and aft berths and an athwartship sofa seat, also fold-up lavatories. Two cabins have wardrobes with drawers under, and the third has drawers under the sofa seat. In plan B there is also a group of 3 cabins, with a total of 5 berths and 2 sofa berths, all placed fore and aft. Fold-up lavatories and chests of drawers,

also sofa seats with drawers under are provided. The peculiarity of design B is that the berth in the inner cabin is placed sufficiently high off the deck to enable part of the foot end of each of the sofa berths to project under it, so saving fore and aft space, as illustrated by the elevation. The fore and aft passage ways were lighted by skid skylights and other suitable means. I think where we naval architects are at a disadvantage is that we do not as a body travel enough. We read our text-books and attend classes and meetings like these, but we need more than these aids to fit us for our work. We need to come more into contact with those whom we seek to serve, hence, with this object in view, we should travel about and see as much as possible. I understand the German students lay themselves out for this, and put themselves to a good deal of inconvenience to see what is being done, far more so than we do. We need to see absolutely what is going on afloat, to get amongst the passengers, speak to them and learn their ideas, acquaint ourselves with the various working departments of the ship, give up your dinner now and again, and see how the dinner is served. See how the stores are stored and issued, and learn the routine work. I speak of passenger ships. By so doing a lot of valuable information will be obtained. In a word, when designing put yourself in the place of those who travel and of those who work the ship. I think we naval architects have done very well, but we can do better. Our friends the foreigners have wisely copied us, and from experimental knowledge have improved on what we have done, but they have had the money, derived from larger subsidies and bounties. Consequently they can afford to spend more than we can do, who have but little more to depend on than the unaided earnings of the passenger traffic. But this is a very large ques-



author. They are a most desirable provision, but you cannot afford to provide many such cabins unless you have revenue derived from other sources than passengers. I believe, had our Government assisted our mail steamship lines as foreign Governments have theirs, we should still have held the blue ribbon of the seas. There is another point I should like to refer to, viz., the value of details. The Americans are ever alive to details, as instanced by their trade catalogues, etc. Comfort, like life, is made up of little things, a jarring door hook for instance. Did you ever endeavour to sleep in a cabin with a jarring door hook? You cannot sleep. But the thing is remedied at once by a little piece of indiarubber inserted in the eye in which the tapered door hook catches. An unsecured door is banging to and fro as the vessel rolls. A little automatic spring will catch the door and cure it. A piece of felt or rubber placed at bearing ends of hard wood framing where liable to creak will keep it quiet. These may seem but trivial matters, but I am sure passengers appreciate them, and they tend materially to give a vessel a good name for comfort. For otherwise the most beautiful apartment will be discounted in the burst of temper provoked by the jarring and banging door or creaking woodwork. We need to pay more heed to these things and get the little details right as well as the broad ideas of our general scheme.

Mr. A. Chisholm said—I rise with great diffidence to speak on a paper by such an able member as Mr. James, and especially after our able friend Mr. De Rusett. He has covered some of the remarks which I had wished to make with reference to the cabin, but there is one more remark which I would like to add which has suggested itself to me. When Mr. James mentions the Bibby arrangement of cabin it seems such an extravagant thing, if we can get light and air without going exactly to the side. In cases where we have deck houses I think that an arrangement of a double coaming might be utilised. (Mr. Chisholm made a sketch on the blackboard showing a span coaming with the incidence of light falling into the inner cabin below—see Plate XXII.) You do not get such a direct light with a square coaming. That is one of the principal items I wished to bring before this meeting, and probably the suggestion may be carried out by some one.

The SECRETARY—I have the two following communications upon this paper. One is from Mr. Cairns, who is with Messrs. Vickers, Maxim & Co., at Barrow-in-Furness, and the other is from Mr. W. L. Hall, of Birmingham, who, I believe, has had a great deal of experience in the setting out of cabins.

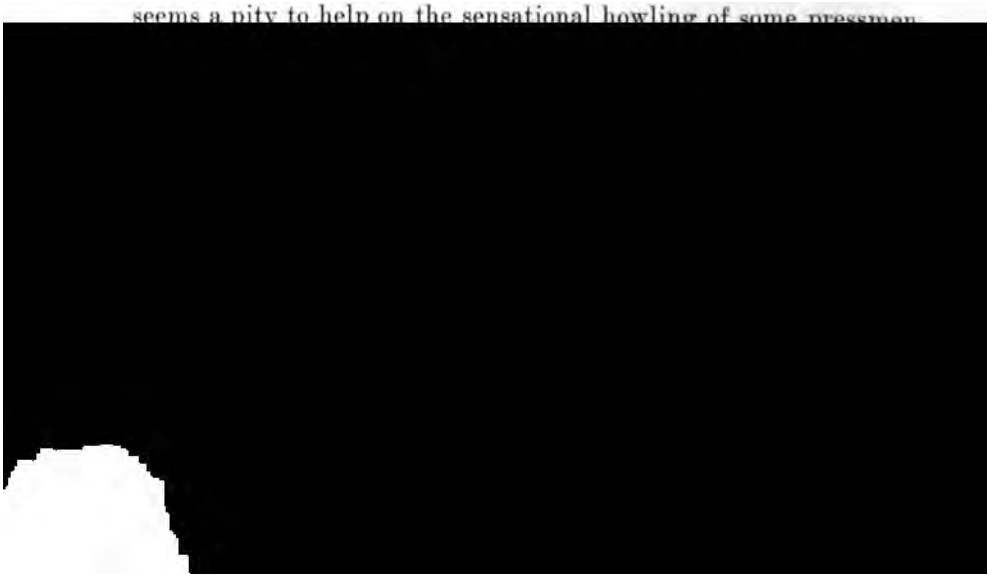
BARROW-IN-FURNESS,
*March 11th*, 1902.

DEAR MR. DUCKITT,

Mr. James's paper will no doubt be of great interest to naval architects. Perhaps the engineering members may in this discussion represent the travelling public as well as themselves, and make a few comments.

I hope Mr. James is not too serious in his contrasting of continental perfection as against British backwardness.

It must not be forgotten that the man (or company) with the latest ship has the advantage of coming into the business when somebody else has shown the way. The most famous of the foreign built passenger ships are of very recent date, whilst in the Atlantic trade, which Mr. James cites, the ships of the greater British lines are in most cases considerably older. Another point to remember is that in many fields of German enterprise, a great deal of go-ahead extension has been done on borrowed money, easily obtained at the time, but on which present circumstances do not seem to promise much return. I do not know whether this applies to German shipping, but it seems to be very general in German industrial affairs. Most of the improvements and advances mentioned by Mr. James are stated to be of British origin. In the face of this, and many other facts, it seems a pity to help on the sensational howling of some pressmen



tion inseparable from high-speed reciprocating engines, even where four-crank arrangements are adopted.

The vibratory effects are usually local in character, perhaps severely felt in one state room, and unnoticeable in another; and unfortunately spring beds as at present fitted respond to the vibrations at any point where they occur: worse than that, they magnify them.

The principle which this nuisance follows may be simply understood by holding up a weight by a spring or by a string of rubber. If the hand be held stationary, and the weight set to vibrate up and down, it will be found that the weight so supported has a natural period or rate of vibration, say 60 times per minute.

If the weight be now brought to rest and a slow regular movement of the hand up and down be made, say 30 times per minute, the weight will be found to follow the hand, and copy its motion, with a travel about one-third greater. If the hand be moved, say 50 times per minute, the motion will again be copied by the weight, but magnified over three times, whilst if the hand be moved 60 times per minute, the motion will become too wild to be dealt with.

Increasing the vibrations per minute of the hand will be found (beyond this rate which coincides with the natural unforced rate) to reduce the motion of the weight, until at 120 per minute the weight will be found to move only about one-third as far as the hand, and beyond this rate still farther decrease takes place, until the weight may even remain practically steady as if oblivious of the movement of the upper end of its elastic support.

More elaborate apparatus for this experiment can be easily devised.

I cannot at present make the experiment mentioned above, although I have made several similar to it, with no more elaborate apparatus than sticks, string, a weight, and a spring such as may be obtained from any ironmonger. So I have taken the factors for comparative motion of hand and weight from a chapter in Professor Perry's *Applied Mechanics*—a chapter which lends an added interest to one's experiences while performing the part of weight, while a ship's berth fills the rôle of spring and the vibrating state-room starts the shaking process.

Here the effect is modified by the friction of the bedding, but in general the case complies with the principles exemplified by the weight and spring just mentioned. We may, therefore, conclude at once that a cure would be found by constructing the beds so as to have a smaller natural frequency of vibration, measured when loaded with a passenger of average weight.

This could be done by:—

(*a*) Increasing the length of spring mattress.

(*b*) Dispensing with spring attachment at sides; supplying instead loosely hanging safety loops to prevent the passenger from falling through between the mattress and frame.

(*c*) Decreasing the tension of the bed, that is, making it of a weaker texture, so that an occupant of a given weight will produce more "sag" than at present.

A combination of these methods would probably "slow" the bed sufficiently to let it cease to magnify the vibration of its points of attachment. They would probably be cheaper than any possible anti-vibration attachment to the ship. A few experiments by those immediately concerned would settle the matter.

I fear I have taken up a lot of time with this apparently trivial matter; but hope it will meet the eye and approval of those that deal with these matters either as superintendents or as bed manufacturers, so that some day we may hope not only for rapid transit, but for a comfortable sleep on the way, free from the sensations of a ride over rough cobble stones.

With regard to the subject of heating, perhaps some of our electrical members could give figures as to the results obtained with electrical heaters, either of the incandescent lamp type, or

TRANMERE, ST. BERNARD'S ROAD,
OLTON, NEAR BIRMINGHAM,
*March 19th*, 1902.

DEAR MR. DUCKITT,

Mr. James's paper has opened up a very interesting subject, especially deserving consideration of North-East Coast shipowners and shipbuilders, to whom in many cases the comfort of the "living freight" has in the past been a "thing of no importance."

Touching first the advances made in passenger cabin accommodation, Mr. James has gone to much trouble in obtaining and giving illustrations of the improvements made in our important passenger lines; and he gives, concisely and clearly, his views (much in advance of the practice of the north-east coast) of what both passenger and general accommodation should be.

There are one or two other systems, however, which may not have come under his notice, and as I think they are worth attention, by request, I now give the particulars, to include in your discussions upon the original paper.

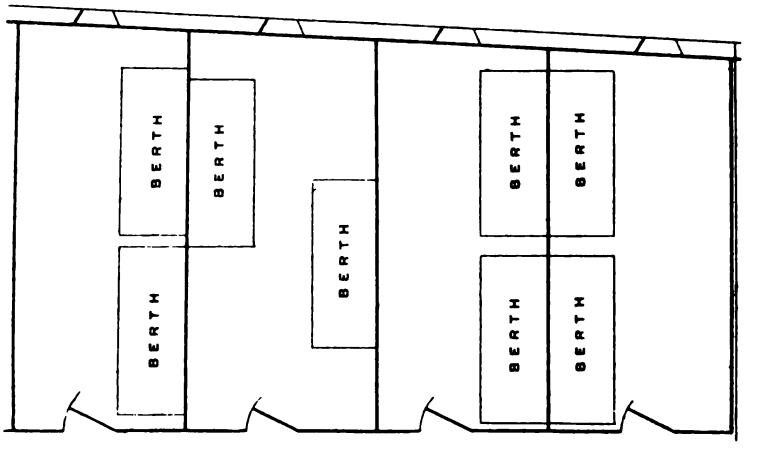
I am not one of those who are always eager to compare themselves with the foreigner, to the praise of the latter—we as a rule set the example, and he, the foreigner, tries to go "one better." In no country has this been more evident than in Germany. I shall show a little further on what they did in their emigrant carrying steamers.

It is interesting to notice first the "expansion of ideas." In former years an oblong wooden box, not more than 6 feet by 2 feet by 7 or 8 inches, without a lid, was all that was allotted to a sleeper, were he tall or short, fat or lean. Then, gradually, it was found that 2 feet 2 inches to 2 feet 3 inches was more suitable for width, and a few inches was occasionally added to the length, until, at the present time, the berths in the New Pacific S. N. Co.'s steamers are all 3 feet wide, and range from 6 feet 6 inches to 6 feet 9¾ inches in length. For the P. and O. Co.'s steamers their minimum length and width is 6 feet 3 inches by 2 feet 2 inches inside. In the recent steamers of the Compania Sud Americana de Vapores the lower berths are 6 feet 0 inches to 6 feet 3 inches by 2 feet 6 inches to 3 feet 3 inches inside width, and I could give several other instances of a like character. All these berths are metallic and folding, of the character recommended by Mr. James.

In the Dutch lines to the West Indies they arrange their berths so that there is free breathing space for each passenger; this is accomplished either by placing one berth fore and aft and the other athwartship, the foot end only of one being over the other, or by having two separate berths in the same level. The rooms are large, which allows of an end standard to one or both berths: thus the sleepers lie foot below foot or independently with open head spaces. There is usually a single berth room in suite with the two berth cabin a very convenient arrangement (see Figs. 1 and 2, Plate XXIII.).

In one of the lines referred to, from which Fig. 1 (Plate XXIII.) is taken, a cot is provided in several of the cabins for a child. This cot is fixed in a convenient position on one of the bulkheads, and being on the folding principle is out of the way when not wanted.

FIG. 3.



are of iron, with special white metal lee rails, having a space in the centre for ingress and egress, so that the sleeper can lie with head at either end. These lee rails fold closely down to the mattress for stowage; therefore when only one person occupies a room the upper berth is removed altogether, simply by lifting it out of the sockets. These sockets being of the same white metal are no disfigurement to the bulkheads.

Some companies trading to Australia adopt a form of berth which enables the rooms to be used as comfortable private day cabins, where the passengers may retire with their friends of the voyage away from the public rooms. In this case the berths are made to revolve and also fold up; one side is upholstered, completely hiding the spring bottom, and on the other side the bedding is confined by the lee rail secured down upon it; in this way, with the lower berth revolved upholstered side up, and the upper berth turned down upholstered side out, there are sofas only in evidence. Private whist parties on long voyages find this an acquisition.

The Italian lines, more particularly the Navigazione Generale Italiana, in addition to folding berths, adopt very largely one of a cot type, with very elaborate white metal lee rails on each side to keep them free of bulkheads, and they do not stint the width, which is overall 2 feet 6 inches.

I give you in Plates XXV., XXVI. and XXVII. some up-to-date state-room furnishings. The berths in each are metallic, the lee rails and more prominent parts being of white metal (known as Neptune silver). The berths in Plate XXV. are on the folding principle, with reversible lees, and were first fitted in an Indian troopship. In Plate XXVI. the berth shown below the port is really a sofa. The bed is the sofa back turned down; it is pivotted to the bulkhead and sofa arm; and for day use the lee rail is folded in the bedding, and when turned up in the housing of the shelf all is out of sight except the upholstery.

Mr. James gives it as his opinion that "berths should be entirely of iron or brass with wire mattresses and somewhat wider than usual." All the instances given above are embodiments of this opinion; the berths are all metallic and in most instances the lee rails are of an exceedingly handsome and elaborate character, made of special white metal, having the device or badge of the Company incorporated in the design, and

in all cases they are either folding berths or standing away from bulkheads, with good air space all round, securing cleanliness and sanitation, which cannot be obtained with the old system of wood berths.

On the question of lavatories: here again metal is preferable to wood, and brass or white metal basins are more durable than those of earthenware; but in the construction of these fittings there should be no projections internally, or covered in parts where scum can be secreted—this is a very important factor—and the waste should discharge into a receiver. The latter, suitably constructed, is in all cases preferable to leading into a main drain. Fold-up lavatories, as described by Mr. James, are the best, and these should contain the chamber lockers instead of having them in a corner of the berth space.

Whilst the foregoing will show the advance made in accommodation for cabin passengers, equal, if not greater, strides have been made in that for third class or steerage, and in this respect Germany no doubt took a very strong lead, with the result that her ships show so favourably in the numbers carried.

About twelve or fourteen years ago the Hamburg-American Line commenced in earnest to compete for this traffic, but they hesitated on the point of how far to go in discarding wood for iron. They commenced with their steamer "Russia," built at Laird's, Birkenhead, to fit up iron berths with wood lee and end boards, the prevailing system at the time being wood shelves in two tiers divided off by wood boards, the better type of accommodation being, for want of any more fitting description, a series of canvas slings with stretching bars supporting the canvas division. I well remember that the firm I was with at the time had

prevailing where the effects of *mal-de-mer* cannot so easily be cleaned away; and now the system is general.

But here again England actually led the way in the Indian troopship "Clive," but of course this was not an emigrant vessel.

Continental emigration laws were less stringent at the period referred to, but America stepped in with such regulations for those clearing from her ports that it became necessary to adopt her standard, and so it has gone on---one better each time—until at the present moment third class—we do not like to call them emigrants—are better catered for than were first class in the earlier days of steam.

Tabular statements have recently been published giving the number of passengers carried to and from America by the various lines. In considering these figures we must go below the surface. For instance, some of the German vessels are fitted for 2,500 steerage passengers or more, chiefly in block form arrangement, and, where divided off, there are 10 or 12 in a compartment, whereas in the American Red Star, Holland-America and some Liverpool Lines the bulk of their third class accommodation is in rooms, for 2, 4 and 6 in a room. These rooms are formed by patented portable bulkheads, so arranged that only as many as are wanted may be erected for each voyage, leaving any surplus space clear for cargo or promenade. This portable cabin system is now becoming more general, and soon there will be very little open block arrangement in the higher class vessels.

Portable and folding washstands have been introduced in connection with these rooms, the fittings being capable of easy stowage in small space, a matter of great consideration from a freight earning point of view.

Of course in any new system it is of primary importance that the novelty should be an efficient one, but unfortunately in the case of metallic berths they have in a few cases got into disrepute owing to the ever repeated cry of cheap, cheap, cheap, inducing people who know nothing of the subject coming forward to meet this demand. A good berth is always cheap, a cheap and inefficient one is always dear, and it therefore behoves every one interested to make such enquiries as will ensure his obtaining the right article from the workshop of those who have made the subject a specialty.

Yours faithfully,

W. L. HALL.

POINTHOUSE SHIPYARD,
GLASGOW,
*March 26th*, 1902.

DEAR MR. DUCKITT,

The "tandem" arrangement of state-rooms shewn in one of the illustrations to Mr. James's paper on "Passenger Accommodation" bears some resemblance to the plan sent herewith (see Plate XXVIII.), and which we adopted fourteen years ago. The single rooms were much appreciated by passengers.

Yours faithfully,
JOHN INGLIS.

The discussion was adjourned.

# WORKSHOP RECORDS: A REVIEW AND COMPARISON OF EXISTING METHODS, WITH SPECIAL REFERENCE TO THE USE OF CARDS AND FILES INSTEAD OF BOOKS.

By GEORGE PARKER. A.C.A. (Associate).

[Read before the Institution in South Shields on March 21st, 1902.]

This paper has been compiled to some extent from personal experience, but mainly from published sources. The major portion of the literature on the subject is of American origin, and indicates that their methods are much more ingenious and scientific than are generally to be found in this country. For the benefit of those gentlemen who may wish to pursue the subject further than the limits of this paper permit, a list of all the most important books and papers relating thereto is given in Appendix I., page 291.

Much has been written lately concerning American competition in every branch of engineering, and many explanations have been offered as to how they are able to undersell British firms; but, so far as the writer is aware, their much more universal knowledge and appreciation of the benefits accruing from a thoroughly efficient system of internal organisation has never been mentioned in this respect. Yet may not this be an important factor in their success?

In America "the principles of the organisation of workshops, including methods of ascertaining and keeping costs, etc.," are taught at many of their technical colleges, and in addition some of their best known firms have published full descriptions of their methods of organisation, so that all who care to read may benefit thereby. In Great Britain, however, this subject has received but scant attention, little or no attempt being made to

teach the young engineer anything of the commercial side of his profession, and most firms in this country believe in keeping their methods of organisation rigidly to themselves.

This reticence and conservatism on the part of British firms is greatly to be deplored, for it is only by being able to make comparisons that the best methods can be arrived at. The advantages to be gained by making such comparisons far outweigh any personal considerations, and in no case need involve the publication of trade secrets or other matters of a private nature.

A modern industrial establishment has been aptly compared to the human body, and there are many points of resemblance; the manager being the brain, the workshop records the nerves, the machinery the bones, and the workmen the muscles. The bones and muscles are dependent on the brain for the initiation of every movement, and in the same manner the employment of the machinery and the workmen is initiated by the manager. In order that these movements may be properly controlled it is necessary that the nervous system should be in proper order, therefore it is a matter of paramount importance that there should be a thoroughly efficient system of workshop records in use in the factory.

So long as a firm continues to make large profits the need of efficient workshop records does not come acutely home, but as soon as competition begins to tell, and these profits decrease and perhaps disappear altogether, the question naturally arises: How and where, if possible, can the cost of production be reduced? This question, a thoroughly efficient system of workshop records alone can satisfactorily answer.

A system of workshop records should have three objective points in view, viz.:—

### Records of Orders for Work to be Done.

These, so far as the factory is concerned, initiate with the manager, who, on receipt of an order from a customer, by the issue of production-orders to the different departments, authorises the work to be done by each.

As nearly every firm has a different system of dealing with these orders, it is quite impossible to do more than sketch the general procedure. The most usual plan is to provide an order book, in which every order is entered as received and its consecutive number put opposite, together with any necessary reference to the estimate book, tender book or letter book. This book is accessible only to the manager and his clerk, no one else being allowed to see it, and its precise form will vary with the class of work turned out by the factory. The first step necessary for putting an order into effect is to give instructions to the head draughtsman to prepare or collect the drawings required. This should be done in writing, either by letter or by direct entry in the drawing office order book. In the drawing office the necessary drawings and working-lists are prepared, so as to provide the officials having charge of the work with full instructions for fulfilling the order, down to the smallest detail. A copy of the working-list, which is really a specification of everything required on the order, is sent to the manager, to the storekeeper and to each foreman who will be employed on the work. The manager has his copy written into the order book, where space is provided for it, and the progress of the work noted. The storekeeper, on receipt of his copy, requisitions the office for all parts, etc., which are not in stock, and they are then ordered from outside in the usual manner. In addition to the working-list copy, general instruction sheets are often issued to the foremen, giving full particulars of the work to be performed and the time in which it must be completed.

The above is briefly a very usual method of procedure, varying in detail to suit different classes of manufacture. Most managers will agree that it has many shortcomings, yet there are many firms much worse off in this respect.

Where cards are used for the purpose of recording orders the procedure may be as follows: On receipt of an order from a customer it is entered on a card, which is filed in the manager's

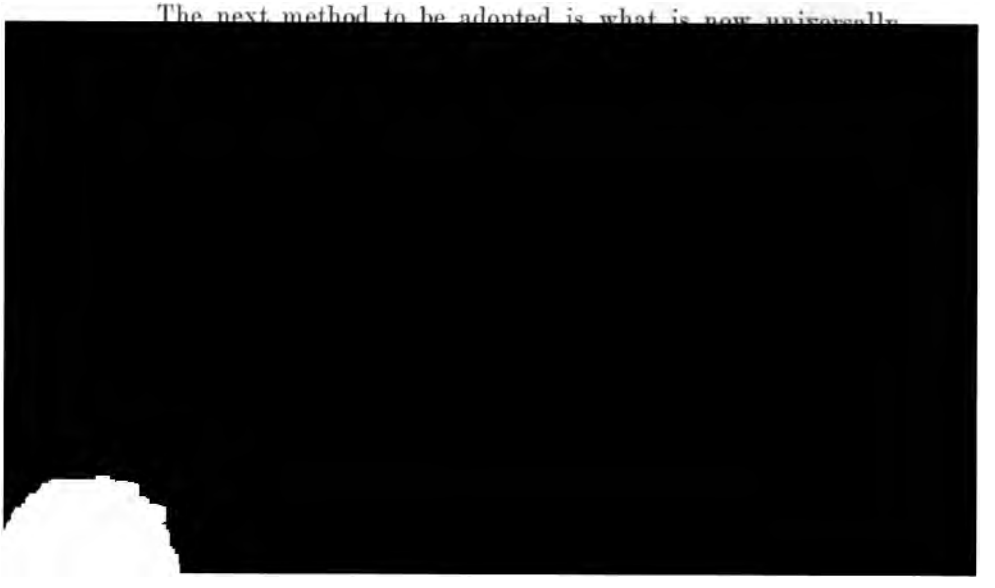
office. From this card other cards called production-orders are made out, one for each piece or service which is required to make up the order, commencing with the drawings. In the drawing office a list of pieces required to complete the order is made out: this list being required to assist in making out the other production-order cards, which may be of different colours in order to facilitate reference. These cards are sent into the shops with the drawings and follow the work from department to department, having the date of their receipt by and transfer from each department endorsed on them. Where separate cards are used to order each part, they may also be made to collect the cost, as will be described later. The records of orders from the foremen to the men really form part of the "Records of Labour" and will be referred to under that heading. The writer is afraid that but a faint idea of the procedure under this heading has been given, but it is difficult to do more while only dealing with general methods.

## Records of Labour.

1.—The record of each man's time of arrival at and departure from work.

The oldest method of getting this information is probably by means of the giving out and return of the men's time-boards as they pass the time office window on arrival and departure. These boards being numbered consecutively, those left in the office after the gate is closed denote the men that are absent. On leaving work each man hands his board in at the time office, it being a fixed rule—no board, no pay. This method has been in use for the past fifty years or more and is still used by some firms.

The next method to be adopted is what is now universally



In both the "board" and "check" systems a time book is necessary to record the actual time each man has worked per day. This book is ruled with columns for each day of the week, and the time entered therein for each section of the day. There are various methods of doing this, some preferring to use marks of some kind instead of figures. Thus in Great Britain the day is usually divided into three sections, in which the working hours may vary at different times of the year, but the exact duration of which is always known to the timekeeper; then three strokes may be used, one for each section of the day, / for time before breakfast, \ for time after breakfast and — for time after dinner, a complete day being represented by a triangle thus △. Owing, however, to the difficulty of convincing the men in the case of dispute, this method is not to be recommended. Where figures are used each day column is divided into four sections, the actual hours worked being entered therein and the fourth section reserved for overtime.

There are now several time-recording clocks on the market which greatly facilitate the keeping of these records. By the use of one of these clocks the time book and its consequent clerical labour is entirely done away with, each man making his own record with the aid of the clock, as he arrives at and leaves the factory. A list of most of the time-recorders now on the market, together with a brief description of their respective capabilities, is given in Appendix III., page 293.

2.—The record of the allocation of each man's time to the proper processes or jobs on which he has been employed.

There are many different methods of making these records, the time-board, with its modifications, being the oldest and the one in most general use in this country. In this system each man is given a time-board (which may be a wood board painted white, a slate, a card, or a slip of paper) on which he is supposed to record how he has spent his time during the day. This is examined and, if correct, signed by the foreman and handed in at the time office every night.

The result is, that, as the majority of men have a great aversion to clerical work of every description, they leave the filling in of their time until the last moment; consequently the details furnished are in most cases little better than guess work. It is quite impossible for the foreman to detect errors unless they are

of a very glaring nature, in fact the most he can do is to see that the proper jobs are entered on the time-board; thus one job often benefits at the expense of another, and heavy losses are incurred on future work through unreliable estimates based on these figures, or work lost owing to too high a price being quoted. These time-boards are transcribed into a book usually called the work book, then, after being agreed with the time book or clock records as to total time, are used in making up the wages analysis, from whence they are posted to the debit of the different orders in the cost ledger.

There are three distinct systems of using cards for this purpose, each of which possesses certain advantages.

1.—The job order system, in which a separate card is used for each job on which a man works. Two examples of job order cards are given in Appendix IV. (Plates XXIX. and XXX.). The first of these cards is used as follows: On entering the shop in the morning each man is furnished with a card, representing the job he is busy on or is to proceed with, which he perforates at the time of commencing work and hangs in front of him. If the foreman wishes to give a man a second job before the first is finished, he fills in the order number and operation to be performed on a second card, which is hung next under the one in use. When a job is finished its card is examined by the foreman, who approves it by signing it, or preferably by punching it with a ticket punch. The second card is used in identically the same manner, except that the times of commencing and finishing are to be entered in writing either by the man himself or by the foreman. If by the foreman, a time-stamp may be used, in which case each foreman should be provided with one for the purpose.

work book or wages analysis. After this the coupons are available for comparative cost purposes of every description.

3. The collective or piece order system, in which a separate card is used for each member or piece of work, irrespective of the number of operations involved in its completion. In this system the card may follow the piece of work, which it represents, through the factory and have recorded on it the time spent in the different processes and operations performed on it; and in addition may be used as the means of transmitting orders as described under the heading of "Records of Orders for Work to be Done." The great objection to this system lies in the difficulty of agreeing the men's gate-time with the time charged to the different jobs on which they have been engaged during the day. This difficulty, however, may be overcome by using advice cards and writing up the collective order cards from them. The men have then nothing to do with the allocation of their time. The foremen are provided with advice cards (an example of which is given in Appendix IV., Plate XXIX.), and one is filled up every time a man finishes one job and commences another. These cards give the time (which may be stamped with a time-stamp) and particulars of the job finished and the new one commenced, and are forwarded to the job clerk at stated intervals every day. The job clerk posts up the collective order cards from them and they are then available for agreeing the men's allocated time with their gate-time. The collective order cards are filed when finished under the heading of the product of which they form a part.

### Records of Material.

Speaking generally there are in all factories raw materials, materials in progress, finished parts and assembled or completed products. A "rough store" and "finished store," it will be found, are therefore essential to getting accurate records, all material starting from the "rough store" and working its way to the "finished store" before being finally issued to the assembling room or erecting shop.

Raw materials are ordered as required through the office and are received on arrival by the storekeeper, who is required to make an independent record of what he receives. This record is sent up to the office, where it is checked against the invoice and original order. A more general system than the above is for the

invoice to be sent to the storekeeper, who is supposed to check it off with the material actually received, but this is a very loose system, especially as the storekeeper then knows exactly what material he has to expect and there is consequently always a direct incentive to scamp the checking. Nothing should be given out by the storekeeper except on properly authenticated orders, such records being kept as will show to whom and on what account materials have been issued.

The most usual method adopted for keeping a record of raw materials is for the storekeeper to be provided with two books named respectively "stores received" and "stores issued." In order to facilitate the checking of the invoices and the posting of the stores issued to the different orders two sets of these books are often provided for use on alternate days or weeks.

Raw materials are issued to the men as required on requisition orders, signed by the foremen, stating the quantity of material required and to what order it is to be charged. Each foreman is usually provided with a requisition book made up of alternate thick and thin leaves and used with a carbon sheet, so that a copy of each requisition always remains for reference. Material ordered specially for an order is often charged direct to the order in question without putting it through the "rough store," but although this may seem to be a saving in clerical labour it may cause a great amount of trouble and worry in order to locate the material when it is required. Where there is a "finished store," practically the same procedure should be observed, the finished parts being received from the shops and issued to the assembling room or erecting shop. In cases where there is no "finished store," finished parts are sent direct into the erecting shop on completion, with the result that a great deal of confusion and worry is often caused when they come to be assembled.

The raw materials issued are posted to the debit of the different orders in the cost ledger either direct from the stores issued book or through the medium of a journal, in which latter case a considerable amount of clerical labour will be involved.

In order that the "rough store" may be worked with any degree of efficiency it is essential that a stores ledger should be kept, in which accounts should be opened for each class or kind of material stocked and the receipts and issues posted up from the stores received and stores issued books. This of course means

a tremendous amount of clerical labour, but the advantages gained will in most cases far outweigh the extra expense incurred. Some difficulty will be met with in opening this ledger in regard to some of the items, such as waste, oil, tallow, etc., but as these are only chargeable to establishment charges account, this difficulty may be overcome by the exercise of a little ingenuity and determination. In arranging the store-rooms it will be well to remember the old adage, "a place for everything and everything in its place," and have properly labelled bins and pigeon holes provided for storage purposes, for on these the efficiency of the store-rooms will to a great extent depend.

By the use of cards the stores received and issued books may be abolished entirely. All material received is recorded on cards, which are filed and sent into the office every day, where they are checked against the orders and the invoices, after which they are filed for the use of the stores ledger clerk. This ledger, consisting of cards filed in a cabinet, is kept in the office on the theory that if the storekeeper wants to know what is in his room he should look in the proper place and find it. Material is issued on receipt of card requisitions from the foremen, these cards also being filed and sent into the office every day for the information of the stores ledger clerk. The storekeeper, having thus no clerical work to perform except on the receipt of material, is able to pay much more attention to his ordinary duties. Another method is to provide a "material card cabinet" in the store-room and require the storekeeper to enter all issues on their proper order card, but this plan cannot be recommended, although it is undoubtedly better than using books for the purpose. In some cases, as a check on waste and carelessness on the part of the foremen, the storekeeper is provided with a list of everything required on each order and is required to honour the foremen's demands to the extent of this list but no further. Should any material be spoiled or lost the foreman must obtain an order from the office before the storekeeper will deliver the material.

No values are inserted on any of these cards at first and the stores ledger is kept in quantities only. A card index file is kept in the office, showing the fluctuations in price of each commodity, a separate card being used for each, and the prices at which they are to be charged varied accordingly at stated intervals. This makes the cost accounts of much greater value, as market fluctua-

tions are at once apparent. As a check on the accuracy of the stores ledger records the stores ledger clerk is required to send to the storekeeper the names of several articles which are in stock, with a request for an actual count of each. This is done every day so that in the course of a month every stock account is checked at least once.

### Records of Establishment Charges.

Although the keeping of these records is often deemed a very simple matter, it is in reality very difficult to carry out properly. It may be done of course very simply by charging everything, which cannot be charged direct to orders, to an account in the commercial books called establishment charges account, but this will afford no information when it is desired to find out where these charges may be reduced. It is only by splitting establishment charges up into their composite items that this information may be arrived at, and it is in this respect that the practical utility of a modern system of workshop records will perhaps be most appreciated by manufacturers. In this country as a rule very little effort is made to subdivide these charges, although the "standing order" system is fairly well known, while in America they are split up into the minutest details, over a hundred subdivisions being quite usual.

In the standing order system a list is prepared of the different headings under which all work done for the factory itself is to be charged, these headings being numbered and called standing orders, and records made by any of the methods already described for customers' orders. There are, however, many other items coming under the heading of establishment charges which

the amount which is necessary to cover it, or as to the manner in which it is to be computed. In this country the usual method adopted is to write off a certain percentage every year from plant and machinery (usually 5 per cent.), from buildings (usually 2½ per cent.), and from loose tools (usually 10 per cent.), no attempt being made to depreciate any of these individually except in very rare instances, although that is a matter of the greatest importance. Thus it is quite a common occurrence to find, in this country, machine tools in use twenty and thirty years old, firms being loth to part with them because their records don't show that their individual values have been written off. If a record of each machine tool was kept, showing the depreciation off every year, firms would be far more willing to get rid of old-fashioned, and costly in upkeep, machine tools.

Individual records of buildings, and machinery and plant may be kept either in books or on cards, but preferably on cards, as dead records can then be at once removed. In the case of many small tools a minimum individual value may be agreed, and those coming under it recorded in groups. An example of a plant record card is shown in Appendix IV. (Plate XXX.).

Loose tools are a very important item, and the American plan of providing a tool-room, or branch store, for their reception is beginning to be largely adopted in this country. This tool-room is provided with suitable racks for storing the tools and with grinders, etc., to keep them in working order, and is in charge of a skilled workman. Tools should never be issued to the shops without a record of the taker, and for this purpose the check system is often used. Each man is provided with five or six brass checks stamped with his individual number, one of which is given to the tool-room keeper whenever a tool is required, and the tool-room keeper places the check in the vacancy left by the tool in its rack. The check thus makes the man stand charged with the missing tool until it is returned to the tool-room, and the man has his check returned therefor. The only objection to this plan is that the men are wholly at the mercy of the tool-room keeper, who is liable to place the checks in the wrong racks, and for this reason cards used as in a library are preferable. As a matter of accounting, loose tools are treated in a variety of ways, the safest being to write off all additions and replacements every year, letting the value stand the same from year to year until some marked increase or decrease is made.

After the total of establishment charges has been arrived at, it becomes necessary to consider how they are to be taken into account as affecting the cost of the different products turned out and commenced during the period which they cover. This leads to the consideration of the different methods of determining the oncost to be borne by the finished and partly finished products. In valuing work-in-progress for balance sheet purposes often no account is taken of oncost, and although this is undoubtedly an error on the safe side, it is nevertheless an error and may seriously injure one year's profits at the expense of another's. Where the question of oncost is properly considered and scientifically dealt with, there is no reason why it should not be charged to the product in an equitable manner at each stage of its manufacture.

There are many different methods of determining oncost, but they all belong to one or other of three classes.

1.—By a percentage on direct or productive labour, based on past or current records.

This is the method in most general use in this country, although owing to its overburdening highly-paid skilled labour and underburdening cheap unskilled labour it gives in many cases far from reliable results. This disability may be somewhat minimised by adopting a different percentage for each class of work.

2.—By an hour rate based on the average number of hours of direct or productive labour.

This is the method usually adopted in America, and except in shops where there is a great diversity in the size and cost of individual tools it will be found to give very reliable results, the loss incurred on cheap labour as in the "percentage method" not having to be made good at the expense of work requiring

This is far and away the most scientific method, for it enables the machinery used to be taken into account in costing work, and this is a most important advantage, especially now that machinery is becoming more and more used in every branch of industry. Many will object to this method as involving too many complications, and except in shops where there are both very large and very small machines it may hardly repay the trouble of installing it, although on the other hand the information afforded will be an undoubted advantage. Applications of the above methods are given in Appendix V., page 293, and it will be observed what a difference there is shewn in the component costs.

## The Card System.

Having described applications of cards for various purposes a brief description of the origin of the system will not be amiss.

The card system has been described as a method of recording, classifying and indexing facts, figures or names of every description by means of cards, uniform in size, arranged on edge in drawers or trays, according to some defined order, with projecting guide cards to facilitate immediate reference. The system originated in Boston, Mass., where it was used for the purpose of indexing library books and recording whether they were out on loan or not. Captain Henry Metcalfe, Ordnance Department, U.S.A., was probably the first to use cards entirely for workshop record purposes. He devised and introduced a system of card records in place of books, while in charge of Frankford arsenal, U.S.A., in 1881, and so far as the writer is aware his system is still is use.

Perhaps the greatest advantage which the card system possesses over books lies in the fact that, by making only one record on each card, the number of possible combinations is practically unlimited, and in addition, except for summary purposes, the record once made serves a variety of purposes without transcription. Writing of this advantage Captain Metcalfe says:—

"Generally speaking, the lower in the scale of combination the unit is, the easier it is to treat it independently in forming such new combinations as may be required. This applies to many examples in everyday life. Take, for example, the printer's type, divided into single letters, how much better it lends itself to forming the great variety of words it is intended to multiply and

preserve than if whole words or even their constituent syllables were cast as single pieces like the ideographic characters of the Chinese or the hieroglyphics of the old Egyptians? In fact, was not the germ of Guttenberg's invention not that of printing only, with which he and his associates are credited, although it is as old as the use of the signet ring, but the printing with movable letters?" This unity of record is invaluable for collecting and collating details of cost both for summary and departmental purposes. Take, for example, a steam engine; each member or part has its cost properly inscribed on a card (or series of cards according to the exact method adopted) and the total of these cards (or series of cards) when collected forms a complete descriptive cost of the engine.

### Points to be Considered on Introducing a New System.

The adoption of more modern methods of organisation and workshop record has probably been contemplated by most managers during recent years, but the absence of reliable information on the subject, together with the fear that work in the shops will be delayed owing to the men not being able to understand them, has undoubtedly deterred many from proceeding further with the matter. In America these difficulties have been overcome, even in shops employing men of different nationality. That being so, why should not the same thing be done here?

In designing a system of workshop records it is essential:—

1.—That all orders, in connection with the expenditure of labour or material, should emanate from one central source.

2.—That all records of work done and expenses incurred under these orders should finally converge towards that same central

The exact methods to be adopted will depend to a large extent on the nature of the product turned out, and to some extent, as regards the time records, on the system of remunerating labour.

In working the system its value will, to a large extent, depend on the judicious issue of the cards. Thus, if costs are required to the smallest detail, separate cards must be used for each piece and each operation performed on it, but this is not often required, the collective order system generally giving all the requisite information.

In using the collective order system, which is the most suitable for marine engineers and the heavy trades, a separate card is used for each component part of the product. The advantages of this are twofold: first, it enables the card to follow the part which it represents right through the shops, going to each man who has work to do on it, and serving the purpose of ordering everything in connection with it; second, it gives the cost in detail, so that when a similar job comes in, an estimate of cost may be made, even though there is some variation in details, by means of appropriate deductions and additions, which will be much more accurate than mere guess work.

As an example of the number of uses to which these piece order cards may be put, it may be mentioned that the Bickford Drill and Tool Company, Cincinnati, Ohio, U.S.A., who use this system, make them serve seven distinct purposes before using them for cost-keeping, viz:—"(1) They furnish the necessary authority for the ordering of material, (2) their receipt by the general foreman tells him that the piece is in the shop ready to be proceeded with, (3) their delivery to departmental foremen indicates the order in which the work is to be done, (4) their stay in the hands of the departmental foremen shows them exactly what work they have ahead, (5) their return to the stock clerk authorises him to issue the material to the shop, (6) their appearance in the drawing office shows that the work has been taken out of the stores, and (7) their location in the job clerk's file signifies whether or not the work is actually in progress. On receipt of an order the job clerk makes out the requisite number of piece order cards from the list furnished by the drawing office. These are sent to the stock clerk, who forwards those for which he has the material in hand to the general foreman and orders the material required to fill those retained."

Having decided on the methods to be pursued in regard to direct expenditure, the method to be adopted for determining oncost remains to be decided on, and method No. 3 is undoubtedly the most reliable for marine engineers, especially where there is a large amount of repair work.

As regards shipbuilders it will be found somewhat more difficult to introduce the card system. In fact many managers will regard the advantages to be gained therefrom as questionable. Yet it is undoubtedly a great advantage to be able to follow the actual cost of each section of a ship during its progress, without having to wait until the ship's account in the commercial books has been dissected and the detailed cost taken out. This the card system will admit of being done, for by its use the records may be made as the work progresses, the cost of each section of the ship being shown on a card (or series of cards), which, being filed together, represent the total cost of the ship. Opinions differ as to the mode of determining oncost to be adopted by shipbuilders, but method No. 1 for all purely yard charges, supplemented by a rate in proportion to the tonnage or the cubic numbers of the ships turned out, will give reliable results. In addition to this the coals used may be kept separate and charged in proportion to the weight of steel or iron worked into the ships. Methods No. 2 or 3 are quite unworkable in a shipyard, as the majority of the men are on piece.

In conclusion the writer ventures to hope that this paper may prove of interest to the Institution and be the forerunner of many others on kindred subjects, for it is to this branch that attention will be most needed in dealing with foreign competition. The writer would also like to suggest that this Institution should

# APPENDIX I.

## LIST OF BOOKS AND PAPERS RELATING TO THE SUBJECT.

### BOOKS.

| | YEAR. |
|---|---|
| "Factory Accounts." Third edition. By E. Garcke and J. M. Fells ... | 1889 |
| "Engineering Estimates and Cost Accounts." By F. G. Burton ... ... | 1896 |
| "Engineering Estimates, Costs, and Accounts." Second edition. By A Works' Manager ... ... ... ... ... ... ... ... | 1896 |
| "The Commercial Organisation of Factories." By J. Slater Lewis .. ... | 1896 |
| "The Commercial Management of Engineering Works." By F. G. Burton | 1899 |
| "The Management of Engineering Workshops." By A. H. Barker ... | 1899 |
| "The Cost of Manufactures and the Administration of Workshops." By Captain H. Metcalfe, U.S.A. ... .. ... ... ... ... ... | 1900 |
| "The Complete Cost Keeper." By H. L. Arnold ... ... ... ... | 1900 |

### PAPERS.

The Transactions of the American Society of Mechanical Engineers :–

| | |
|---|---|
| "The Nomenclature of Machine Details." By Oberlin Smith ... ... | 1881 |
| "The Shop-order System of Accounts." By Captain H. Metcalfe ... | 1886 |
| "A Short Way to Keep Time and Cost." By Henry Leon Binsse | 1888 |
| "Estimating the Cost of Foundry Work." By George L. Fowler ... | 1888 |
| "An Accurate Cost-keeping System." By H. M. Norris ... ... | 1897 |

The Engineering Magazine :—

| | |
|---|---|
| "Modern Machine Shop Economics." Six papers. By H. L. Arnold | 1893 |
| "Cost-keeping in Machine Shop and Foundry." Four papers. By H. Roland ... ... ... ... ... ... ... ... | 1897 |
| "Effective Systems of Finding and Keeping Shop Costs." Eight papers. By H. Roland ... ... ... ... ... ... | 1898 |
| "A Simple and Effective System of Shop Cost-keeping." By H. M. Norris ... ... ... ... ... ... ... ... | 1898 |
| "Machine Shop Management in Europe and America." Eight papers. By H. F. L. Orcutt ... ... ... ... ... ... | 1899 |
| "Shop Cost-keeping and General Expense." Three papers. By H. M. Norris ... ... ... ... ... ... ... ... | 1899 |
| "Works' Management for the Maximum of Production." Four papers. By J. Slater Lewis ... ... ... ... ... ... ... | 1899 |
| "The Commercial Organisation of the Machine Shop." Six papers. By Hugo Diemer ... ... ... ... ... ... ... | 1900 |
| "Cost-keeping: A Subject of Fundamental Importance." By J. N. Gunn ... ... ... ... ... ... ... ... | 1901 |
| "The Proper Distribution of Establishment Charges." Six papers. By A. H. Church ... ... ... ... ... ... ... | 1901 |

North-East Coast Institution of Engineers and Shipbuilders :—

| | |
|---|---|
| "On Works' Organisation." By T. Westgarth ... ... ... ... | 1898 |
| "Shop and General Establishment Charges in Engineering Works and their relation to Costs and Estimates." By W. E. Cowens ... | 1898 |
| "Some Remarks on the Commercial Organisation of Shipyards." By Walter Scott ... ... ... ... ... ... ... ... | 1901 |

The Institution of Shipbuilders and Engineers in Scotland :–

| | |
|---|---|
| "Workshop Administration." By David Cowan ... ... ... | 1900 |

| | YEAR. |
|---|---|
| "The Administration of Workshops, with Special Reference to Oncost." By David Cowan ... ... ... ... ... ... ... | 1901 |
| The International Time-Recording Company:— | |
| "How to Do It: The Rochester Card System." By W. S. Rogers ... | 1900 |
| The American Machinist:— | |
| "Cost-keeping at the Chicago Works of Fraser & Chalmers." Two Papers. By J. A. Thomas ... ... ... ... ... ... | 1900 |
| "The Principles of Cost Accounting." Two papers. By F. A. Halsey | 1901 |
| The Institution of Junior Engineers:— | |
| "The Management of Engineering Workshops." Six papers. By A. H. Barker ... ... ... ... ... ... ... ... | 1901 |
| The International Engineering Congress, Glasgow:— | |
| "Workshop Methods." By W. Weir and J. R. Richmond ... ... | 1901 |
| "A Premium System of Remunerating Labour." By James Rowan ... | 1901 |
| The Sheffield Incorporated Society of Chartered Accountants:— | |
| "The Cost Accounts of an Engineer and Ironfounder." By J. W. Best, F.C.A. ... ... ... ... ... ... ... ... | 1901 |

## APPENDIX II.

### DEFINITIONS OF TERMS.

*Assets.*—Property of every description.

*Balance Sheet.*—A summary or statement showing a firm's financial position at a given date.

*Commercial Books.*—The books relating to the office accounting, such as the ledger, journal, and cash book; as distinguished from the factory books.

*Cost of Production.*—The total expenditure incurred in the production of a commodity. This term is distinguished from prime cost in that the latter term does not cover the whole cost of production.

*Depreciation.* The falling off in value of machinery, plant, buildings, loose tools, and other assets, owing to wear and tear.

*Factory Accounting.* The systematic record of all transactions incidental to manufacture.

*General or Establishment Charges.*—The expenditure incidental to maintaining an industrial establishment in a proper state of efficiency, and which cannot be directly charged to any particular process or order.

*Gross or Total Cost.*—Prime cost plus oncost.

## APPENDIX III.

### LIST OF TIME-RECORDING CLOCKS, ETC.

*The Rochester Card Recorder.*—This clock records on cards, each man being provided with a card which he places in a slot in the clock on arrival at, and departure from, work, and the time is printed on the card by pushing down a lever. The same procedure is observed in dealing with the cost cards, the men printing their time of commencing and finishing each job by the aid of the clock.

*The Bundy Key Recorder.*—This clock records on a strip of paper inside of the clock. Each employee is provided with a key, which is inserted in the clock on arrival at and departure from work. The objection to this system is that the records are in the order in which they are made and consequently awkward for reference.

*The "Dey" Time Register.*—This clock is provided with a dial numbered round its circumference and a movable pointer in the centre. The men on arrival at, and departure from, work move the pointer round to their distinctive numbers and press, and the clock prints the time on a strip inside.

*The Autograph.*—This clock records on a strip of paper inside on pressing a lever. Each employee pulls down the lever, which opens a slide disclosing the paper strip, signs his name, and the clock prints the time opposite.

*The Dial Recorder.*—This clock is similar to the "Dey," the records being made on a circular piece of paper.

*The Simplex Time Recorder.*—This clock records on paper strips inside and is provided with numbered buttons, which, on being pressed, perforate the paper strip, and thus record the time.

*The Stockall Time Recorder.*—This clock is similar in many respects to the Rochester described above, and it is claimed as an advantage that the card, when placed in the slot for recording, disappears out of the sight and control of the workman.

*The Standard Time Stamp.*—This stamp is provided with clock mechanism and it prints the date and time of day. It is chiefly for the use of foremen in stamping the job tickets.

## APPENDIX IV. (*see* Plates XXIX. and XXX.).

## APPENDIX V.

### EXAMPLES OF THE THREE METHODS OF DETERMINING ONCOST.

A firm of engineers turn out, during the year, work costing £8,320, which they dispose of for £10,000, leaving a profit of £1,680.

This output is made up of four contracts as follows: – No. 1 for £1,600, No. 2 for £1,500, No. 3 for £2,400, and No. 4 for £4,500; total, £10,000. The costs of these contracts in material and labour are as follows;—

| Contract No. 1. | £ | s. | d. |
|---|---|---|---|
| Material ... ... ... | 500 | 0 | 0 |
| Labour ... ... ... | 500 | 0 | 0 |
| Prime Cost ... | £1,000 | 0 | 0 |

| Contract No. 2. | £ | s. | d. |
|---|---|---|---|
| Material ... ... ... | 600 | 0 | 0 |
| Labour ... ... ... | 400 | 0 | 0 |
| Prime Cost ... | £1,000 | 0 | 0 |

| Contract No. 3. | £ | s. | d. |
|---|---|---|---|
| Material ... ... ... | 460 | 0 | 0 |
| Labour ... ... ... | 860 | 0 | 0 |
| Prime Cost ... | £1,320 | 0 | 0 |

| Contract No. 4. | £ | s. | d. |
|---|---|---|---|
| Material ... ... ... | 1,000 | 0 | 0 |
| Labour ... ... ... | 1,120 | 0 | 0 |
| Prime Cost ... | £2,120 | 0 | 0 |

The establishment charges amount to £2,880, and on reference to the comparative statement (page 295) it will be observed that this is equal to :—By the percentage method, 100 per cent. on direct labour ; by the hour-rate method, 8d. per hour of direct labour ; and by the machine-rate and overhead-rate method, 1s. per hour for heavy machines, 6d. per hour for light machines, 3d. per hour for hand work, and 1d. per hour overhead rate (assuming of course that there are only two classes of machines). Applying these factors, the following results will be shown :—

| | Prime Cost. | Oncost. | | | Total Cost. | | | Price. | Profit. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Method No. 1. | £ | £ | s. | d. | £ | s. | d. | £ | £ | s. | d. |
| Contract 1 ... ... | 1,000 | 500 | 0 | 0 | 1,500 | 0 | 0 | 1,600 | 100 | 0 | 0 |
| Contract 2 ... ... | 1,000 | 400 | 0 | 0 | 1,400 | 0 | 0 | 1,500 | 100 | 0 | 0 |
| Contract 3 ... ... | 1,320 | 860 | 0 | 0 | 2,180 | 0 | 0 | 2,400 | 220 | 0 | 0 |
| Contract 4 ... ... | 2,120 | 1,120 | 0 | 0 | 3,240 | 0 | 0 | 4,500 | 1,260 | 0 | 0 |
| Totals... ... | 5,440 | 2,880 | 0 | 0 | 8,320 | 0 | 0 | 10,000 | 1,680 | 0 | 0 |
| Method No. 2. | | | | | | | | | | | |
| Contract 1 ... ... | 1,000 | 503 | 6 | 8 | 1,503 | 6 | 8 | 1,600 | 96 | 13 | 4 |
| Contract 2 ... ... | 1,000 | 446 | 13 | 4 | 1,446 | 13 | 4 | 1,500 | 53 | 6 | 8 |
| Contract 3 ... ... | 1,320 | 820 | 0 | 0 | 2,140 | 0 | 0 | 2,400 | 260 | 0 | 0 |
| Contract 4 ... ... | 2,120 | 1,110 | 0 | 0 | 3,230 | 0 | 0 | 4,500 | 1,270 | 0 | 0 |
| Totals... ... | 5,440 | 2,880 | 0 | 0 | 8,320 | 0 | 0 | 10,000 | 1,680 | 0 | 0 |
| Method No. 3. | | | | | | | | | | | |

| | Method No. 1. | | | Method No. 2. | | | Method No. 3. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Material and Labour. | Oncost 100 per cent. | Total Cost. | Material and Labour. | Oncost 8d. per hour. | Total Cost. | Material and Labour. | Machine Rate. | | Overhead Rate. | | Total Cost. |
| | £ | £ | £ | £ | £ s. d. | £ s. d. | £ | @ | £ s. d. | @ | £ s. d. | £ s. d. |
| **Contract No. 1.** | | | | | | | | | | | | |
| Material ... ... ... ... | 500 | ... | 500 | 500 | ..... | 500 0 0 | 500 | ... | ..... | ... | ..... | 500 0 0 |
| Labour ... ... ... ... | ... | ... | ... | ... | ..... | ..... | ... | ... | ..... | ... | ..... | ..... |
| Machinists H. 4,000 hrs. at 6d. | 100 | 100 | 200 | 100 | 133 6 8 | 233 6 8 | 100 | 1s. | 200 0 0 | 1d. | 16 13 4 | 316 13 4 |
| ,, L. 7,500 ,, 8d. | 250 | 250 | 500 | 250 | 250 0 0 | 500 0 0 | 250 | 6d. | 187 10 0 | 1d. | 31 5 0 | 468 15 0 |
| Fitters, etc. 3,600 ,, 10d. | 150 | 150 | 300 | 150 | 120 0 0 | 270 0 0 | 150 | 3d. | 45 0 0 | 1d. | 15 0 0 | 210 0 0 |
| Totals 15,100 ... ... | 1,000 | 500 | 1,500 | 1,000 | 503 6 8 | 1,503 0 8 | 1,000 | ... | 432 10 0 | ... | 62 18 4 | 1,495 8 4 |
| **Contract No. 2.** | | | | | | | | | | | | |
| Material ... ... ... ... | 600 | ... | 600 | 600 | ..... | 600 0 0 | 600 | ... | ..... | ... | ..... | 600 0 0 |
| Labour ... ... ... ... | ... | ... | ... | ... | ..... | ..... | ... | ... | ..... | ... | ..... | ..... |
| Machinists H. 8,000 hrs. at 6d. | 200 | 200 | 400 | 200 | 266 13 4 | 466 13 4 | 200 | 1s. | 400 0 0 | 1d. | 33 6 8 | 633 6 8 |
| ,, L. 3,000 ,, 8d. | 100 | 100 | 200 | 100 | 100 0 0 | 200 0 0 | 100 | 6d. | 75 0 0 | 1d. | 12 10 0 | 187 10 0 |
| Fitters, etc. 2,400 ,, 10d. | 100 | 100 | 200 | 100 | 80 0 0 | 180 0 0 | 100 | 3d. | 30 0 0 | 1d. | 10 0 0 | 140 0 0 |
| Totals 13,400 ... ... | 1,000 | 400 | 1,400 | 1,000 | 446 13 4 | 1,446 13 4 | 1,000 | ... | 505 0 0 | ... | 55 16 8 | 1,560 16 8 |
| **Contract No. 3.** | | | | | | | | | | | | |
| Material ... ... ... ... | 460 | .. | 460 | 460 | ..... | 460 0 0 | 460 | ... | ..... | ... | ..... | 460 0 0 |
| Labour ... ... ... ... | ... | ... | ... | ... | ..... | ..... | ... | ... | ..... | ... | ..... | ..... |
| Machinists H. 6,000 hrs. at 6d. | 150 | 150 | 300 | 150 | 200 0 0 | 350 0 0 | 150 | 1s. | 300 0 0 | 1d. | 25 0 0 | 475 0 0 |
| ,, L. 7,800 ,, 8d. | 260 | 260 | 520 | 260 | 260 0 0 | 520 0 0 | 260 | 6d. | 195 0 0 | 1d. | 32 10 0 | 487 10 0 |
| Fitters, etc. 10,800 ,, 10d. | 450 | 450 | 900 | 450 | 360 0 0 | 810 0 0 | 450 | 3d. | 135 0 0 | 1d. | 45 0 0 | 630 0 0 |
| Totals 24,600 ... .. | 1,320 | 860 | 2,180 | 1,320 | 820 0 0 | 2,140 0 0 | 1,320 | ... | 630 0 0 | ... | 102 10 0 | 2,052 10 0 |
| **Contract No. 4.** | | | | | | | | | | | | |
| Material ... ... ... ... | 1,000 | ... | 1,000 | 1,000 | .. ... | 1,000 0 0 | 1,000 | ... | ..... | ... | ..... | 1,000 0 0 |
| Labour ... ... ... ... | ... | ... | ... | ... | ..... | ..... | ... | ... | ..... | ... | ..... | ..... |
| Machinists H. 10,800 hrs. at 6d. | 270 | 270 | 540 | 270 | 360 0 0 | 630 0 0 | 270 | 1s. | 540 0 0 | 1d. | 45 0 0 | 855 0 0 |
| ,, L. 10,500 ,, 8d. | 350 | 350 | 700 | 350 | 350 0 0 | 700 0 0 | 350 | 6d. | 262 10 0 | 1d. | 43 15 0 | 656 5 0 |
| Fitters, etc. 12,000 ,, 10d. | 500 | 500 | 1,000 | 500 | 400 0 0 | 900 0 0 | 500 | 3d. | 150 0 0 | 1d. | 50 0 0 | 700 0 0 |
| Totals 33,300 ... .. | 2,120 | 1,120 | 3,240 | 2,120 | 1,110 0 0 | 3,230 0 0 | 2,120 | ... | 952 10 0 | ... | 138 15 0 | 3,211 5 0 |
| Totals 86,400 ... ... | 5,440 | 2,880 | 8,320 | 5,440 | 2,880 0 0 | 8,320 0 0 | 5,440 | ... | 2,520 0 0 | .. | 360 0 0 | 8,320 0 0 |

# NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

EIGHTEENTH SESSION, 1901-1902.

## PROCEEDINGS.

SIXTH GENERAL MEETING OF THE SESSION, HELD IN THE LECTURE HALL OF THE SUNDERLAND LITERARY SOCIETY, FAWCETT STREET, SUNDERLAND, ON FRIDAY EVENING, APRIL 18TH, 1902.

HENRY WITHY, ESQ., J.P., PRESIDENT, IN THE CHAIR.

The SECRETARY read the minutes of the previous meeting, held in South Shields on March 21st, 1902, which were approved by the members present and signed by the Chairman.

The ballot for new members having been taken, the President appointed Mr. G. D. Wear and Mr. Hugo MacColl to examine the voting papers, and the following gentlemen were declared elected:—

MEMBERS.

**Coninck, Gastin de**, N.A. Student, 2, Summerhill East, Sunderland.

**Little, Frank**, Electrical Engineer, 31, Westgate Road, Newcastle-upon-Tyne.

ASSOCIATE.

**Gore, Thomas Hodgekin**, Steamship Manager, 52, Queen's Square, Bristol.

## NOMINATIONS FOR COUNCIL.

The PRESIDENT announced that in accordance with Article X. of the Constitution, the following gentlemen would retire from the Council:—

*President*—Mr. Henry Withy (not eligible for re-election).

*Vice-Presidents*—Mr. G. H. Baines, Mr. John Tweedy, and Col. P. Watts (eligible for re-election).

*Hon. Treasurer*—Mr. G. E. Macarthy (eligible for re-election.

*Ordinary Members of the Council*—Messrs. W. C. Borrowman, E. H. Craggs, Alfred Harrison, Andrew Laing, David Myles (not eligible for re-election as Councilmen).

In accordance with Bye-Law 11, the President, on behalf of the Council, nominated the following gentlemen to be balloted for to fill the vacancies, and intimated that members could add to the list:—

*President*—Mr. John Tweedy (Neptune Works, Walker).

*Vice-Presidents*—Mr. G. H. Baines, Mr. W. C. Borrowman, Mr. E. H. Craggs, and Mr. Alfred Harrison (three to be elected).

*Hon. Treasurer*—Mr. G. E. Macarthy.

*Ordinary Members of the Council*—Mr. John Allan, Mr. George Clark, Mr. Edwin Griffith, Mr. George Jones, Mr. J. R. Perrett, Mr. J. L. Twaddell (five to be elected).

Mr. G. D. WEIR nominated Mr. D. Myles as a Vice-President.

## RESUMED DISCUSSION ON MR. M. C. JAMES'S PAPER ON "PASSENGER ACCOMMODATION IN STEAMSHIPS."

The SECRETARY said—At our last meeting, I submitted a communication from Mr. W. L. Hall, of Birmingham, on this subject. Since then Mr. Hall has sent me a number of drawings of arrangements with regard to state-rooms, etc., in ships, which I have added to his communication. Mr. Hall has taken a great deal of pains, one way and another, to give us what he knows about the matter, and he has also written me to the effect that he is in communication with shipbuilders on the continent with the hope of getting more drawings from them on the subject. These will enhance the value of the paper that has been put before us by Mr. James.

Mr. JAMES said—I must first of all tender my thanks to our esteemed President for his explanatory statement regarding the statistics he quoted in his post-prandial remarks made at Newcastle in January last. The figures as they originally appeared in the daily press were somewhat misleading, and tended to cause one to draw erroneous deductions from them. By the courtesy of Messrs. Ismay, Imrie & Co., I have been put in possession of very complete analyses of the Atlantic passenger traffic. These tables by permission of the Council will be embodied in the *Transactions*,* and they will be found well worth careful study. They go to show that the preponderance in numbers of the steerage passengers carried by the German steamers is due to the heavy emigration consequent on conscription, and also to the geographical position of the German lines. I am afraid I must plead my somewhat timeworn experience of wedlock as my excuse for having forgotten to refer to the bridal chambers which are so popular and so frequently patronised on the modern liners. In this connection I also neglected to mention that centuries ago old Archimedes thoughtfully provided on that marvellous ship of his a very elegant room for Venus.

* See pages 302, 303 and 304.

Mr. De Rusett's remarks are very interesting, and they are of special value on account of his intimate knowledge of the subject. I am sorry that I aroused his patriotic ire by the use of the word "neglect." I certainly never intended it to apply to all British Passenger Steamship Companies. The White Star Line, for instance, is far and away ahead of any other passenger line in the Atlantic passenger trade, and is immensely and deservedly popular even with the hypercritical American voyager.

I quite concur with Mr. De Rusett on his opinion that it is very desirable for naval architects to get experience on board ship, for they are then better able to justly appreciate the importance of what are apt to appear superficially as trivial and unimportant details.

The double coaming described by Mr. Chisholm is a most ingenious arrangement for getting light and air to inner cabins, but in practice it is found that ports in skid skylights are never so satisfactory either for affording light or ventilation as ports fitted on the ship's side.

Mr. C. W. Cairns has partly missed the point of my strictures on the tendency to conservation displayed by some British lines; it was not necessary for me to take my cue from pressmen—who, by the way, generally get hopelessly at sea when dealing with maritime matters—my opinions were formed, rightly or wrongly, by intercourse with ocean travellers and actual experiences of my own. I had no intention to cast any slur on the ability of the men who design and build British passenger ships. They were the pioneers, and as such have much to be proud of, but unfortunately they rarely have a free hand in arranging cabin accommodation or fittings, each shipping company having pet arrangements of their own, which they insist on having

tions of the special berth arrangements to which he refers are most instructive, and will form a useful addition to our *Transactions*. Mr. Hall has had exceptional opportunities of noting the changes and improvements effected in passenger accommodation, and I observe with much satisfaction that he sustains my complaint as to certain British Lines having been slow moving in the matter.

In support of my statement respecting the progressive policy of the German Lines, I cannot do better than quote the following extract from an article which appeared only this week in the *Shipping Gazette*. Summing up a review of the recently published Annual Report of the North German Lloyds, it goes on to say:—

"Equally does it suggest that the Germans intend to be second to none in the contest for ocean supremacy. The Norddeutscher Lloyd has adopted wireless telegraphy, and is making further experiments with German systems of the same means of communication. The Hamburg-America Company has made extensive experiments with oil fuel, which have proved satisfactory from a technical standpoint, but less so from a financial aspect. Both companies meantime are taking steps to assure for themselves independent coal supplies. The Norddeutscher Company reports a series of interesting experiments in towage, which have led to material alterations in the shape of hulls, and have given new ideas even to the Imperial Navy. Contemporaneously with these excursions into the field of naval architecture, the company's workshops at Bremen and Bremerhaven have been enlarged and re-organised, new machine tools introduced, and the latest American notions in the shape of factory installation adopted. The energy of the Teutons is, in a word, surprising. Much of it is doubtless due to the fact that, whether in shipowning or shipbuilding, they are less hampered by tradition than ourselves."

The sketch sent by Dr. Inglis shows a similar arrangement to that described by Mr. De Rusett, and it is interesting to note that it was fitted so long as 14 years ago.

In conclusion I beg to thank all those gentlemen who have been good enough to come forward with comments or communications on my paper, and I sincerely hope it has served the purpose for which it was written, namely, to open up this important subject, for that full consideration and criticism which so many members of this Institute are so well able to bestow upon it.

The PRESIDENT said—I am sure the meeting will wish me to propose that a most hearty vote of thanks be given to Mr. James for his paper. It has been a very interesting paper, and the discussion also has been interesting.

The proposition was carried by acclamation.

[redacted]

NUMBER OF CABIN AND STEERAGE PASSENGERS LANDED AT THE PORT OF NEW YORK DURING THE YEAR 1901 BY THE FOLLOWING STEAMSHIP LINES:—

| | Where From. | Agents. | Cabin. | Steerage. | Trips. |
|---|---|---|---|---|---|
| ... | Bremen ... ... | Oelrichs & Co. ... .. ... ... ... | 20,403 | 76,804 | 86 |
| ... | Hamburg ... | Emil L. Boas ... ... ... ... ... | 20,524 | 63,223 | 106 |
| .. | Havre ... ... | Compagnie Generale Transatlantique ... | 7,279 | 35,961 | 54 |
| ... | Antwerp ... | International Navigation Co. ... ... | 6,241 | 32,793 | 52 |
| ... | Liverpool ... | White Star Line ... ... ... ... | 18,167 | 30,483 | 66 |
| ... | Rotterdam ... | J. R. Wierdsma ... ... ... ... | 5,595 | 25,966 | 51 |
| ... | Mediterranean ... | Hirzel, Feltman & Co. ... ... ... | 538 | 24,690 | 27 |
| ... | Mediterranean ... | Oelrichs & Co. ... ... ... ... ... | 2,557 | 24,580 | 36 |
| ... | Liverpool ... | Vernon H. Brown & Co. ... ... ... | 17,783 | 19,943 | 57 |
| ... | Mediterranean ... | Henderson Bros. ... ... ... .. | 70 | 16,132 | 34 |
| ... | Mediterranean ... | Emil L. Boas ... ... ... ... ... | 453 | 15,337 | 25 |
| ... | Mediterranean ... | James W. Elwell & Co. ... ... ... | 33 | 14,165 | 29 |
| ... | Mediterranean ... | Bolognesi, Hartfield & Co. ... ... ... | 493 | 13,505 | 14 |
| ... | Southampton ... | International Navigation Co. ... ... | 12,110 | 12,511 | 39 |
| ... | Mediterranean ... | C. B. Richard & Co. ... ... ... ... | 158 | 12,445 | 17 |
| ... | Glasgow ... ... | Henderson Bros. ... ... ... ... | 7,577 | 6,756 | 40 |
| ... | Copenhagen ... | Funch, Edye & Co. ... ... ... ... | 947 | 4,408 | 20 |
| ... | Oporto .. ... | Hagemeyer & Brünn ... ... ... ... | 104 | 2,607 | 10 |
| ... | Lisbon ... ... | Adolph Falck, Passenger Agent ... ... | 106 | 1,814 | 5 |
| ... | Mediterranean ... | J. M. Ceballos & Co. ... ... ... ... | 53 | 1,751 | 8 |
| ... | Glasgow ... ... | Austin, Baldwin & Co. ... ... ... | 2,386 | 1,114 | 30 |
| .. | London ... ... | Atlantic Transport Co. General Agents ... | 4,194 | — | 57 |
| ... | —— | —— | 372 | 1,880 | 24 |
| | | | 128,143 | 438,868 | 887 |

WM. C. MOORE, Landing Agent.

SUMMARY OF STATEMENT OF THE EASTBOUND AND WESTBOUND BRITISH PASSENGER BUSINESS, INCLUDING CARRYING OF SCANDINAVIA-AMERICAN LINE. COMPILED BY MR. SANDFORD, 1901.

| Westbound. | | | | | | Eastbound. | | | |
|---|---|---|---|---|---|---|---|---|---|
| Trips. | Saloon. | Second. | Third. | Line. | Service. | Trips. | Saloon. | Second. | Third. |
| 10 | — | 296 | 733 | Allan (Glasgow) ... ... | Boston ... ... ... | — | — | — | — |
| 30 | 596 | 1,778 | 1,143 | Allan State ... ... ... | New York ... ... | 28 | 451 | 994 | 250 |
| 45 | — | 3,280 | 8,407 | American ... ... ... | Philadelphia ... ... | 46 | — | 2,494 | 2,509 |
| 39 | 6,180 | 5,030 | 12,510 | Do. ... ... .. | Southampton ... ... | 39 | 4,129 | 3,146 | 5,606 |
| 40 | 2,169 | 5,406 | 6,760 | Anchor ... ... .. | Glasgow ... ... | 40 | 1,779 | 3,439 | 2,553 |
| 57 | 4,182 | — | — | Atlantic Transport ... ... | New York ... ... | 61 | 4,639 | - | — |
| 57 | 8,388 | 9,394 | 19,933 | Cunard ... ... ... ... | Do. ... ... | 57 | 8,733 | 6,554 | 10,314 |
| 30 | 1,291 | 2,061 | 16,683 | Do. ... ... ... ... | Boston ... ... ... | 30 | 1,258 | 1,368 | 4,787 |
| 23 | 2,689 | 3,237 | 9,369 | Dominion ... ... ... | Do. ... ... ... | 23 | 2,463 | 2,042 | 5,040 |
| 43 | 931 | — | — | Leyland ... ... ... ... | Do. ... ... ... | 48 | 1,001 | — | — |
| 11 | 299 | — | — | Do. ... ... ... ... | New York ... ... | 13 | 296 | - | — |
| 20 | 271 | 660 | 4,252 | Scandinavia-American ... ... | Do. ... ... | 20 | 226 | 521 | 1,573 |
| 66 | 11,306 | 6,865 | 30,462 | White Star ... ... ... | Do. ... ... | 66 | 10,102 | 4,898 | 14,724 |
| 20 | 89 | — | — | Wilson ... ... ... ... | Do. ... ... | 15 | 93 | — | — |
| 491 | 38,391 | 38,007 | 110,252 | Total to United States ... ... | | 486 | 35,170 | 25,456 | 47,356 |
| 46 | 2,573 | 4,500 | 12,731 | Allan (Liverpool) ... ... | Montreal, Portland, &c. | 46 | 2,063 | 2,561 | 2,747 |
| 17 | 270 | 173 | 378 | Do. ... ... | Halifax and St. John's | 22 | 225 | 58 | 159 |
| 16 | 88 | 1,033 | 366 | Allan (Glasgow) ... ... | Montreal ... ... | 5 | 43 | 90 | 19 |
| 31 | 725 | 895 | 4,302 | Dominion ... ... ... | Portland ... ... | 31 | 664 | 492 | 826 |
| 45 | 1,019 | 1,976 | 20,677 | Beaver .. ... ... ... | Montreal and St. John's | 43 | 899 | 1,085 | 1,332 |
| 155 | 4,675 | 8,577 | 38,454 | Total to Canada ... ... | | 147 | 3,894 | 4,286 | 5,083 |
| 646 | 43,066 | 46,584 | 148,706 | Grand Total ... ... | | 633 | 39,064 | 29,742 | 52,439 |

STATEMENT OF THE WESTBOUND AND EASTBOUND CONTINENTAL PASSENGER BUSINESS.
PREPARED BY LAWSON SANDFORD, 1901.

| | | | | Eastbound. | | | |
|---|---|---|---|---|---|---|---|
| ird. | Line. | Service. | Trips. | Saloon. | Second. | Third. |
| 604 | Franco-Canadian ... ... | Quebec ... ... | 6 | 38 | 12 | 62 |
| ,973 | French Line ... ... ... | New York ... ... | 54 | 2,913 | 2,586 | 11,970 |
| ,463 | Hamburg-American (Express) | Do. ... ... | 30 | 6,425 | 3,746 | 6,531 } |
| ,168 | Do. (Regular) | Do. ... ... | 53 | 3,032 | 4,578 | 6,066 } |
| ,231 | Do. Union ... | Do. ... ... | — | — | — | — |
| ,744 | Do. Hansa ... | Montreal ... ... | — | — | — | — |
| ,967 | Holland-America ... ... | New York ... ... | 51 | 2,203 | 2,494 | 6,017 |
| ,426 | N. G. L. (Express) ... ... | Do. ... ... | 31 | 5,291 | 3,512 | 10,862 } |
| ,378 | Do. (Regular) ... .. | Do. ... ... | 44 | 3,426 | 2,965 | 7,918 } |
| ,719 | Do. ... ... ... ... | Baltimore ... .. | 35 | — | 722 | 1,408 |
| 865 | Do. ... ... ... ... | Galveston ... ... | 18 | — | 167 | 387 |
| ,786 | Red Star ... ... ... ... | New York ... ... | 50 | 1,598 | 3,332 | 8,541 |
| ,243 | Do. ... ... ... ... | Philadelphia ... ... | 19 | 5 | — | 312 |
| ,567 | Total ... ... ... ... | | 391 | 24,931 | 24,114 | 60,074 |

## DISCUSSION ON MR. GEORGE PARKER'S PAPER ON "WORKSHOP RECORDS."

Mr. HUGO MACCOLL said—I think we are much indebted to Mr. Parker for bringing this subject before us. It is a subject of great interest to all engaged in engineering manufacture. In one of his remarks, Mr. Parker says that we English engineers are rather reticent in giving our experience and disclosing our methods of costing, therefore if my remarks appear egotistical my excuse is that they are made with the object of combating this statement. The most efficient method of costing must vary in different establishments, according to the size of the works and the nature of the manufacture carried on. I regret that Mr. Parker has given us no idea as to cost of costing under the different systems he has put before us.

In the little establishment with which I am connected the cost of costing comes out at less than one-half per cent. of the value of the material and wages dealt with, including the distribution of stores and the allocation of wages, materials and stores to whatever they have to be charged to. I should like to know how the cost of costing under those more scientific methods Mr. Parker advocates works out in comparison with the figure I have given. I may say that to some extent I am still a disciple of the old time-board system, and I think it will require to be clearly proved that more complicated methods are better before they will be generally adopted. As I already remarked each establishment has its own special requirements, but I know that costing is a thing that is carried too far in many workshops, that is to say, there is too much money wasted upon it. It is necessary to get the accurate costs of certain details for estimating, but average results are more reliable for this purpose than the cost of many separate items.

One of the methods I have adopted to reduce costs is to do away with the half-penny in all accounts. Where wages are over a half-penny the men get the penny, and where they are under the half-penny they do not get it. Another system I introduced was in regard to the method of keeping the time

book. I have before me a sheet of the book we use which we had to get up specially for ourselves. There is one book of this kind used each week. There is a space for each man, giving his name, board number, and his occupation, then the hours he works in each day, the rate in another column, and the total wages paid per week. There are columns for each particular contract under which the men are working, and the amount allocated to different jobs must agree with the total that is paid to any man. Then the columns for each particular contract are totalled down, carried forward to the next page, and in the end we have a statement shewing so much wages paid and the amount chargeable to each contract or repair. From these weekly statements costs are grouped together once a month and carried to the proper account in the ledger. The material is dealt with in an exactly similar manner, a statement shews the materials paid for each month and the contracts to which they are chargeable. All material is in this way charged directly to the contract for which it is ordered, with the exception of such material as is chargeable to general stores which are divided under different sections according to certain classifications. Materials are charged to these sections, and from these are charged by the storeman to particular contracts on orders given by the foreman in exchange for these stores when issued to the shops.

The working out of the wage cost involved many calculations of the value of so many hours at different rates per week, to be charged to the different work in progress.

I was unable to find a satisfactory ready reckoner for this purpose, and we had to make one. The difficulty we experienced with the ready reckoners in the market was that about four read-

but with a little practice even for our cumbrous system it is exceedingly useful. I do not wish to condemn a system I know very little about, but one has one's own ideas, and I should like to know where the system of sending round tickets with each piece of work is adopted, how often these tickets go astray and are lost. I should think frequently. I have often had great assistance from foremen making suggestions as to improved methods and appliances by which costs can be reduced, and would much rather encourage foremen to use their brains in that direction, than to have them running all over the place punching tickets like a tramcar conductor.

Another theory which I take objection to is contained in the statement that "so long as a firm continues to make large profits the need of efficient workshop records does not come acutely home;" wherever there is a sharp manager he will always be on the look-out to reduce his costs even in good times. I do not see why a man must be forced to do so. He should be constantly alive to the advantages of, and constantly looking for, methods by which savings can be made. As a works manager, I have often discovered methods which have saved hundreds of pounds, without even referring to cost sheets at all. Although differing from some of the statements in the paper, I feel that great credit is due to Mr. Parker for the manner in which he has placed this subject before us, and I hope a good discussion will take place upon it.

Mr HENRY WEATHERALL said—I would like to say that I welcome the introduction of this subject by one who is, like myself, not an engineer, because clerical men are usually timid in entering the arena of discussion among practical engineers, but Mr. Parker having broken the ice, we can, without seeming egotistical, take part in this discussion. I have been connected with Richardsons, Westgarth & Co., Ltd., of Hartlepool, for thirty-four years. During that period I have gone through every department, and gained some experience in the taking of time from workmen. There is no doubt the time-board system is bad. We have twice tried the system of sending a man round the works each day to take the time from the men. Many years ago we tried the experiment in the lathe shop, and found it worked well. We are now working a similar system in

the iron foundry, and think it is very good. We have obtained most accurate data for costs in this way. I think the card system might work in a small place; but in a place like ours, with something like 1,000 different jobs every week, if these cards should go from one department to another, as has been suggested, what would they be like? Take a small note that may have to be sent up to any of the departments, for an answer, the answer is generally scribbled on the same piece of paper, and when it comes back you can scarcely read it for grease and dirt. What would be the state of a card going through every department? The gentleman who has just spoken has hit upon the weakness of the card system as far as it affects the foremen. It seems to me it would place too much clerical labour upon them. Our manager has always been trying to reduce the clerical work of the foremen. Speaking of time-recording clocks, we have tried one for the general and drawing office, and it works well, but it is of no assistance in the allocation of time. I believe the day will come when clocks will be introduced into every shop. Speaking of cards Mr. Parker said, "In this system the card may follow the piece which it represents through the factory, and have recorded on it the time spent in the different processes and operations performed upon it." I am afraid when it got back into the office there would be little to be seen on it. We, like the gentleman who had just spoken, found that the calculators placed upon the market to calculate the men's time when the 53 hours was introduced were very cumbersome and slow. I, however, made a calculator myself, and we have used it ever since. We find it of considerable assistance, and I am now putting it on the market. I feel very

worked in the shops by a draughtsman and a staff of apprentices, and as the system is only on trial, I cannot venture an opinion upon it yet, but believe it is working satisfactorily.

The PRESIDENT said—I do not propose to close the discussion on this paper to-night. One of our members, who is an engine-builder on the Clyde, and who does a good deal in the way of the card system, has expressed his intention of speaking, and would have been here to-night, but has met with an accident. He says he hopes to be at the meeting on the 9th of May, and therefore I will not close the discussion, but leave it open in the hope that he may be able to come. You may remember his partner, Mr. Thomson, spoke here in this room on the paper dealing with the speed of tools.

The discussion stood adjourned.

# CO-OPERATION AND MECHANICAL AIDS TO WORKSHOP COST-KEEPING.

By R. P. LINK.

[Read before the Institution in Sunderland, on April 18th, 1902.]

How to obtain the co-operation of the workpeople has been at all times a matter of paramount interest to employers, because it is the harmonious working of employer and employee that engenders the atmosphere of confidence, which ultimately leads to success by assisting the introduction of notions and methods and machines which would otherwise be very frequently welcomed only by signs of dissatisfaction, obstinacy, and in some cases by open rupture. Therefore it behoves every employer to call into existence that feeling of good fellowship which should exist between master and man, whereby both receive something for which they have been striving, and which will be advantageous to each.

How to make a start, or go about the work is a puzzle. Many managers lack experience, or have not the time to grapple with the subject in a successful manner. This may be due to the fact that industrial conditions are constantly changing. The employer was to be found working with his men at one stage of industrial history. Growth of business has been such that to-day the employees in large concerns seldom if ever come into direct relations with the responsible head, and an intermediary has long since become essential. This intermediary, originated by the huge growth of our present day works and mills, has assumed various names and guises.

In small concerns the mediation is personal—it takes the shape of a foreman or manager, but in larger concerns, it is represented by a system—a whole set of controlling factors whose efforts all tend to the same ends, viz., the better management of the business, a close record of what is actually being done, and a sharp look-out for possible economies and improvements.

The widespread interest that masters are evincing in this question has lead to the introduction of improvements whereby the condition of the workman or workwoman is brought under more refining influences. But though it is quite an easy matter for business men to take the initiative and give to their employees opportunities for bettering their moral and social conditions, it is not so easy to obtain in return co-operation of the particular kind required for the management and progress of the business.

This probably may be due to two causes—lack of time on the part of the employer to properly organize his works, or possibly, a lack of knowledge as to how to go about it.

If such a movement is to grow and become of lasting benefit, it must have elements of interest to the employer as well as to the workman. This is the great and difficult problem that faces every employer who wishes to improve the condition of his hands, not only during the time they are under control, but so that the germ thus planted may at the same time create an interest on the part of the employee that will be considered, and deeply worked out, and thought over by the latter—a process of evolution which will tend to make an all-round improvement in his position. The solution cannot be found by making a few employees concessions of the more pleasing and interesting kind, such as libraries and mutual improvement societies, and letting it rest there. Something of a more practical nature is necessary, whereby the workman is induced not only to give his best endeavours to his master, but by so doing create for himself a distinction which will bring him to the front. To obtain this result I would suggest to the business man who is contemplating doing something for the industrial betterment of his employees, that he should approach his subject from the standpoint of co-operation in office and

betterment of conditions and opportunities for advancement in the way of greater production, but mainly in the co-operation which will be offered by the employee in the direction of providing the necessary record of what is actually going on. Therefore the relations in each case are the same. Both combinations—man and food, and betterment and the introduction of new methods—work for the same object, force, energy and knowledge.

How to obtain accurate data upon which to base prime cost calculations has always been a burning question. The strenuousness of present day competition has rendered it more than ever imperative that an exact account of the cost of labour should be kept, as it is only by strict attention to minute details of the cost of production that economies in construction can be effected and profits increased.

All systems of shop cost-keeping have for their ultimate object the placing of the manufacturer in the position (1) of being able to fix his price on the article manufactured; and (2) of being able to see in what direction savings and economies can be effected. Every establishment engaged in manufacture must therefore have some system or method of keeping shop costs. The methods at present in use are for the greater part imperfect, and whilst furnishing sufficient data on which to roughly base selling prices, they do not go far enough in the direction of giving details. In other words, they do not particularize, and thus do not enable the manufacturer to determine the processes or parts in which saving may be effected. This particularizing is the essence of the "card system" of shop cost-keeping, and is the argument which will appeal most to intelligent managers or manufacturing concerns. A well-thought-out and elaborated system of shop cost-keeping will not only effect a large saving, but will, by its accuracy, enable the concern using it to estimate with such certainty, that loss on tenders and contracts will be next to impossible. The first essential in producing a system of shop cost-keeping is that it should furnish an accurate return of the time taken by any worker or gang of workers to produce any given article, and when this is realized the details can be worked out with comparative ease.

The general plan or idea of all card systems of shop cost-keeping is the same, the variations depend entirely upon the conditions obtaining in the factory to be equipped.

The past three years have shown us that it is America and

Germany which will for the future be our rivals and competitors for the world's trade, therefore it behoves us to consider the methods in vogue in their most successful industries, that we may, perchance, find amongst them improvements and advances upon our own. It will be admitted that America's success in the engineering and allied trades is largely if not wholly due to the existence of the standardizing system of manufacture which obtains there. This will be the more readily understood and allowed when we consider how much this is the day of the specialist. In all walks of life men are aiming to do one thing well, rather than many things fairly—the physician, the surgeon, the aurist, the oculist are now directing their energies towards distinction in one branch of their respective professions. American engineers have realised this to the full, and by confining themselves to the manufacture or construction of one type of tool or engine have brought their methods to a high state of efficiency.

I do not propose to discuss the question of the relative values of American and British manufactures, but merely to draw attention to evidences of success of American methods and to try to discover how such success has been gained. It is a *sine qua non* to successful trading that accurate and exact returns of the actual cost of any specific article in material, establishment charges and labour should be available, and such returns should furnish the minutest details of the cost of performing any operation on any part of any article.

It has been my endeavour therefore to find if it is possible to bring before you any practical system of shop cost-keeping which will furnish all the data I have alluded to. I may here say

These machines when used in combination with one another give such positive results, with such accuracy, that prime cost, instead of being the bane of the employer's existence, becomes a pleasure, because he learns that when he has such infallible workers, mistakes and errors are not possible. It is not my intention to describe during this reading the various ways in which these machines are operated (although I shall be pleased to do so at some future date, should the subject be deemed a sufficiently interesting one to the members of this Institution), but simply to illustrate the working of the most important of automatic clerical machines, viz.:—The Time-Recorder. These machines are driven by clocks, and I will endeavour to describe to you some of the uses to which they are put.

There are many classes of machines, but the object aimed at in all cases is precisely the same—a more accurate result, and the economising of time which is the most expensive part of shop practice, and a subject which every master is open to discuss.

To come to the machines proper. There is the simple time-recorder, which is used for the purpose of obtaining the exact time that each man commences and finishes his day's work. There is the machine that can be applied to cost-keeping, and upon which nearly all details can be worked out, such as the time taken to perform any operation on a given article, to make any given part, and to produce the completed article. Then there is the machine that gives the time that a tool commenced and finished work, the depth of cut, and whether the tool on which the performing apparatus is set has been running without working. So that it will be evident to you that the clock of the present day is made not only to keep time but also to keep records.

Wherever these clocks are used in connection with the recording of costs they are also used in connection with the card system. Now the card system of handling shop costs is the most elastic of any kind known, as it can be adapted to local conditions to any desired extent, with the one result, correctness. For this work the cards are drawn up so that full details of the particular job are given, and at the same time space is provided for the registration to show the actual time spent on the job or operation specified on the card. The recorders are fixed at various points throughout the works, selected so as to be most convenient and accessible to the men.

Before the commencement of manufacturing operations can take place, a production order has, under any system, to be issued from the office to the shop. What becomes of that order once it has entered into the shop for manufacture, and the unsatisfactory way in which time spent upon it is recorded on the system known as the board system, is best known to those who have the misfortune to depend on such a method. I think I can say without risk of contradiction, that in any works or factory where the board system is in use, it is not only impossible to obtain data of cost that is correct in every detail, but that it never has been and never will be possible, until the conditions that now exist are completely swept away and an entirely new system be adopted, namely, the card system.

The disadvantages of the board system are many, but the most serious is its utter want of reliability.

Suppose for instance an employee has operated upon a dozen different jobs during the course of the day. Can it be reasonably expected that he will be able at night when he makes up his time-board to remember how long he operated upon each article? The average man is born honest and is honest, but he cannot avoid errors in the calculation of his time for the reason that few memories are infallible.

Now to obtain prime, or as it is sometimes called production, cost of any article, two factors are necessary: —(1) Cost of material, and (2) accurate knowledge of what every process on every part has cost. Unless these at least are known, it is impossible to discover whether any particular line of manufacture is paying or not. And how this necessary accuracy is to be attained when the recording of time is left to the workman—who rarely looks upon

following established routine as closely as is compatible with efficiency, unnecessary irritation and friction may be avoided. Efficiency is what must be aimed and arrived at, and upon no account must it be sacrificed; bearing in mind that it is only by having an efficient cost-clerk that such perfect systems of control can be carried out. Probably it will involve the services of an additional clerk, but a good business man is open to take up any proposal if he can perceive a return for his trouble and expenditure.

But the outlay is after all a trifling matter compared with the results obtained, the risks avoided and the saving generally effected by having modern and perfect systems in use. The recording of the time of employees by machine instead of by memory is sufficient in itself to commend the method to employers.

Look, for instance, at the usual method of taking time at the gate of a factory having one entrance, and the different shops scattered about, as in a shipyard, or all contained under one roof, but on different floors. The employee enters by the gate, and possibly not feeling as energetic as it is usual for him to feel, takes a stroll round the works, or visits different floors to discuss a question of weight with a fellow-employee. What is the result? He does not arrive at his bench or machine until a considerable time after having passed the gate and taken up his board.

In some cases the shops are as much as five minutes walk from the entrance, so that if a man is of such sound principles that he wishes to commence his labour at the stated hour, he is not able to do so owing to his having five minutes' walk ahead of him.

Now, with the machine system, the recorders are fixed in the shops themselves, so that the men are compelled to be in their workshops by the stated time of commencing, so as to enable them to register. This in itself is sufficient to compel notice. The loss of five minutes per man on a hundred men entering and leaving a factory four times per day, amounts to £75 per annum, and on 1,000 hands to the considerable sum of £750.

What is to stop this leakage, and save these golden hours and sovereigns? Only "system" is necessary.

I will now give you some details of such a system, with its three different variations in method. In the first of these, time is registered on cards against each man, day by day, in the manner already familiar to users of the time-board system: in the second, a separate job card is provided for each item of work; and in the

third a card is apportioned to each piece of work or part, and follows this part throughout its whole career in the shops from the time when the casting is issued to its final arrival in the finished stores, all time spent on it being recorded on the card.

Let us consider the first of these. The records of time being on a card enable the record to be arranged in such a way that it will accommodate any particular class of work or labour. The entering of piece work, premium work, or the distribution of ordinary time worked on several jobs, can all be recorded on such cards.

The checking of the total time of employees, as I will now describe it, is being successfully carried out in hundreds of engineering shops to-day. Each man is furnished with a card, or rather two cards. The first or No. 1 card bearing the times of arrival and departure on Thursday, Saturday, and Tuesday; the second or No. 2 card being devoted to Friday, Monday, and Wednesday.

On his arrival on Thursday morning the workman takes his card from a rack placed alongside of the machine, inserts it in a slot, thus registering his time, and then places the card in a small tin case, which he also takes from the rack or some convenient place. On the back of the cards space is provided for the particulars of the different jobs, upon which he has been engaged during the morning. The man carries the card and case in his pocket all day long.

When he returns after the dinner hour he again registers his time by means of the recorder, using the back of the card, as before, to record particulars of jobs worked on during the afternoon. Then when leaving work for the night he registers his

he can make them there and then while the matter is fresh. Again the time office is not troubled with disputes, because it holds absolute evidence as to the actual hours of work, while the prime cost department gets its data fresh, and fresh every day, and, by posting time closely, the cost accounts can be kept really up to date, and the expenditure on any job which may be in progress is readily ascertained.

This last is an all-important result, which goes far to ensure success in business. To know what is being done, what it costs, and why it costs what it does cost, is the most valuable information that a manufacturer can have, and as this knowledge can be readily obtained by intelligent use of automatic time-recorders, I think it will be admitted that we have here an important advance in method.

In the second variety of cost-keeping on this method already mentioned, a separate job card is provided for each item of work performed. To successfully work this system a sufficiently large number of recorders must be used to guard against loss of time by the workmen having to go a long distance to and from the recorder, or on the other hand, what is still worse, loss of time by having to wait in turns to use the machine.

Presuming that the foreman in charge of the shop is efficient and is able to keep his men fully employed, the system works out in the following way:—The men are furnished with cards, lasting usually for a whole week, upon which they register their time of arrival and departure much in the same way as in the first method just described. But in addition to this the system provides for the automatic control of the allocation of the man's time to the jobs he is working on. This is effected by means of a job card. When the foreman puts a man on a new job he gives him a card on which the job number, the symbol, and particulars of the part and process are indicated. When it is delivered to him, the man registers the time of commencement by inserting it into the slot of a recorder, and similarly when he finishes the job the time of completion is recorded by the clock in just the same way. He then returns the card to the foreman, who should of course have another job (with its accompanying card) in readiness for him. At the end of the day all these job cards are collected, and the time as shown on each totalled and agreed with the time shown on the men's ordinary attendance time card. The job cards are

then sorted into their respective order numbers by the cost department, thus providing an exact account for each order; not only of what it has cost for labour in the aggregate, but showing exactly of what details such aggregate is made up.

In dealing with a system of this kind it must be borne in mind that failure is bound to result if an insufficient number of machines are provided, and the very object aimed at will be defeated. The success of all such organization depends on the completeness with which its essential features are recognized and introduced.

For repetition work, or for jobs lasting a fair length of time, this method is admirable, but for small work and repairs I have in my mind a plan which employs a mechanical device of a different style, and which I hope to describe to you on some other occasion—I refer to the time-stamp.

The third method of keeping costs on cards registered by time-recorders is sometimes known as the "way-bill system," because each piece of work (such as a piston rod) is accompanied in its progress through the shop by a single card on which are registered the particulars of all work done on the job. This plan applies where work is issued and re-issued from the rough stores, until it is finally completed and entered in the books of the finished store. The cards are ruled so as to provide spaces for registration over a considerable period, such as a month. The registration of time of commencement and finishing of each process is conducted on exactly the same plan as in the second system just described. The main difference between the two systems being that these way-bill cards are not collected daily but remain along with the work they represent until the latter is finally completed.

It will frequently happen that before the job is completed it

cumbrous systems which are used to-day, the clearness and definiteness of the information provided by such a system as this is remarkable.

These brief outlines of systems of checking labour-cost are based upon personal knowledge of methods actually in use in England, America and Germany, and there can be no doubt that if such methods are gradually and tactfully introduced good results are inevitable. The whole question is one of education, and I am sure that the British workman with all his faults is capable of being educated and trained to a higher pitch than that which he at present reaches.

My object in reading this paper was simply to endeavour to bring to your notice the superiority of the machine control system over the method most generally in use at the moment, namely, the board system. There is at present a manifest feeling of dissatisfaction with existing methods of dealing with prime costs. This in itself is a healthy sign. Every manager therefore owes it to himself and to his company to investigate every system that is brought to his notice, as it is only by such investigation and by comparison with his own methods that weak spots are laid bare, and when once these are discovered means can usually be found to strengthen them.

I should like to take this opportunity of saying that any experience I have, or any information I can obtain, I shall be pleased to hold entirely at the disposal of any of the members of this Institution.

Mr. LINK submitted a number of cards which are actually in use in American, German, and English workshops.

The discussion on the paper was adjourned until the next meeting.

The meeting then dissolved.

# NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

EIGHTEENTH SESSION, 1901-1902.

## PROCEEDINGS.

SEVENTH AND CLOSING BUSINESS MEETING OF THE SESSION, HELD IN THE LECTURE THEATRE OF THE LITERARY AND PHILOSOPHICAL SOCIETY, NEWCASTLE-UPON-TYNE, ON FRIDAY EVENING, MAY 9TH, 1902.

HENRY WITHY, ESQ., J.P., PRESIDENT, IN THE CHAIR.

The SECRETARY read the minutes of the previous General Meeting held at Sunderland on the 18th April, 1902, which were confirmed by the members present and signed by the President.

The SECRETARY said—With regard to the ballot for new members, four other gentlemen have been nominated as members of this Institution since the nomination circulars were issued. Their names were brought before the Council, by whom they have been approved. What we have generally done in a case of this sort is to put the names before you, and, if approved of, they are elected as if ballotted for. The names of the gentlemen are:—

Thomas Charles Dawson, Engineer, c/o Messrs. Baird Brothers, Bull Ring Engine Works, North Shields.

Henry Maxson Wilson, Consulting Engineer, 42, Grosvenor Road, Newcastle-upon-Tyne.

E. Hall-Brown, Engineer, St. Helens Engine Works, Govan, Glasgow.

Gerald Storey, Engineer, c/o Messrs. C. A. Parsons & Co., Heaton, Newcastle-upon-Tyne.

The meeting unanimously approved of the names, and they were declared elected.

The PRESIDENT appointed Mr. A. Harrison and Mr. R. H. Muir to examine the voting papers, and the following gentlemen were also declared elected:—

MEMBERS.

Baggallay, Robert, Consulting Engineer, Messrs. Flannery, Baggallay & Johnson, 9, Fenchurch Street, London, E.C.

Dixon, Harold Raylton, Shipbuilder, Messrs. Sir Raylton Dixon & Co., Limited, Shipbuilders, Middlesbrough.

Jarvis, Horace William, Engineer, West Dyke, Coatham, Redcar.

Whyte, James Anderson, Superintendent Engineer, 196, Watt Street, Glasgow.

ASSOCIATE.

Dixon, Thomas, Secretary, Messrs. Sir Raylton Dixon & Co., Limited, Shipbuilders, Middlesbrough.

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The discussion on Mr. George Parker's paper on "Workshop Records" was resumed and closed.

The discussion on Mr. R. P. Link's paper on "Co-operation

## DISCUSSION ON MR. GEORGE PARKER'S PAPER ON "WORKSHOP RECORDS."

The PRESIDENT said—Mr. Parker's paper would have been closed at the last meeting, but as Mr. Rowan expressed by letter a desire to speak the discussion was adjourned until to-night to afford him the opportunity of so doing.

Mr. JAMES ROWAN (Glasgow) said—America, American machinery, American organisation and everything American has undoubtedly been the fashion in engineering circles during the last few years, and, like many people associated with engineering, Mr. Parker has fallen a victim to this fashion. In the very first paragraph of his paper he tells us that the major portion of the literature on the subject "Workshop Records" is of American origin; yet, in Appendix No. I., of the eight books quoted, six are published in this country, and by English authors, and only two in America. Five Institutions and magazines in this country and four in America are responsible for the papers quoted. These figures indicate that the subject has received the fullest appreciation in this country. He says:—"In Great Britain, however, this subject has received but scant attention . . . and most firms in this country believe in keeping their methods of organisation rigidly to themselves. This reticence and conservatism on the part of British firms is greatly to be deplored, for it is only by being able to make comparisons that the best methods can be arrived at." On this point everyone can, of course, only speak from his own experience. We have compared, as manufacturers of marine engines and boilers, weights, prices, cost-keeping, book-keeping and organisation, with many firms, the principals of some of which are members of this Institution. We have exhibited to them our books in every detail, and they have been equally frank and open with us.

Mr. Parker also states that "so long as a firm continues to make large profits the need of efficient workshop records does not come acutely home, but as soon as competition begins to tell, and these profits decrease and perhaps disappear altogether,

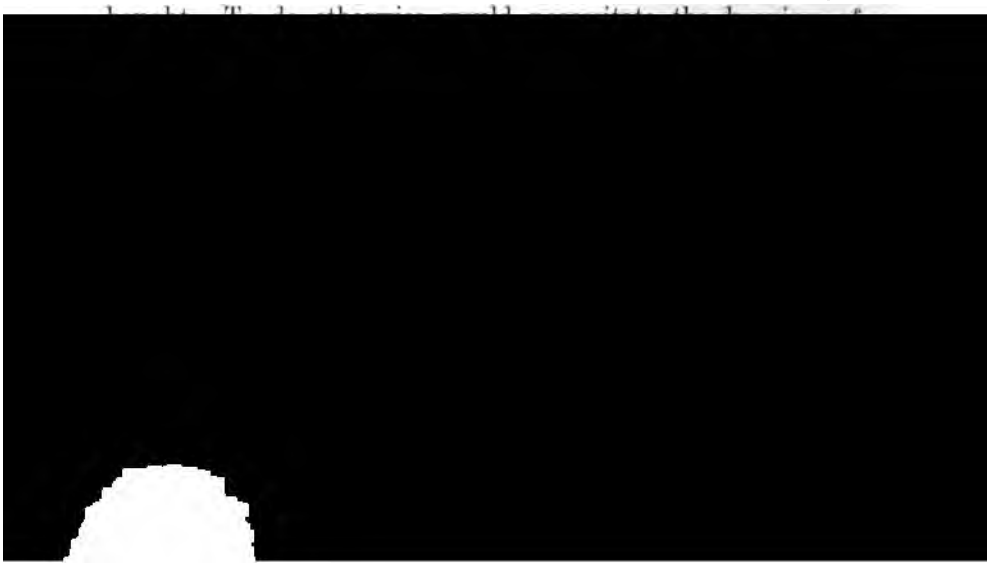
the question naturally arises, How and where, if possible, can the cost of production be reduced? This question, a thoroughly efficient system of workshop records alone can satisfactorily answer." The prominence given here to records is out of all proportion to their value. The question of how and where cost of production can be reduced can only be answered satisfactorily by a combination of improved workshop management assisted by workshop records. No system of records, however complete, will reduce the cost of production in the slightest degree if the administrative powers be deficient. All that can be claimed for a record system is that it may be of assistance in bringing before the notice of the management details which might otherwise be overlooked. The importance which Mr. Parker attaches to records frequently leads to mischievous results, as there is generally a tendency to rely upon the records to the extent of making them serve the purpose of personal supervision. A great deal of recording is done which may be of interest but of no value, as for example:—I get a return of every fortnightly pay after the wages are allocated shewing how the money has been spent. It takes our clerk about an hour to make up this return for me. If it took him two hours I should stop it, as it is really of no value. Again, on the 10th of the month, I get a return of the money spent during the previous month on the wages and material for each job. This is also interesting, but of no value.

On "Records of Labour" Mr. Parker tells us that "by the use of time-recording clocks, the time book and its consequent clerical labour is entirely done away with, each man making his own record with the aid of the clock as he arrives at and leaves

Under "Records of Material" Mr. Parker considers "Rough Stores" and "Finished Stores" essential to accurate cost-keeping. It will be apparent to those conversant with the requirements of a marine engineering or heavy work establishment, that to pass everything through these stores would involve a great deal of unnecessary labour, and besides these are not essential to giving accurate results. The usual practice in such works is for all material bought against contracts to arrive at the works distinctly marked with the contract number for which it is intended, and for the material to be taken direct, if possible, to the machine where it is to be operated upon; and it is certainly much more convenient to send direct to the erecting shop finished parts, rather than pass them through a finished store. Raw materials on arrival should be accompanied by receive notes bearing quantities and weights, and these receive notes, after being checked, should be sent to the counting house and there compared with the orders and with the invoices, and if scamping takes place the responsibility rests with the management. There is no advantage to be gained, but a great deal of trouble would be caused, by the foremen's requisition books being made to be used with a carbon sheet so that a copy of each requisition might be kept by the foreman. It is unnecessary to keep a copy of these requisitions for reference. Our method of requisitioning stores and recording their issue is somewhat as follows:—

The foremen have books of requisition forms arranged with provision for date, job number, description, quantities and weights of goods required, and for the foreman's and storeman's initials. The foreman fills up an order, say for twenty studs and nuts, specifying all these particulars excepting weight, and hands it to a workman. The storeman executes the order, fills in the weight, and initials it. These orders are sent to the counting house every evening and constitute the stores issue records. The stores ledger shews the goods received and issued by storemen. This book is regularly posted in the counting house, is sufficient check on the storemen, and does not involve a tremendous amount of clerical labour. As a matter of fact, we find that the labour involved amounts to very little. It is done for us by a young lad of sixteen or seventeen years of age; he does it correctly, and is able to do a good deal more work, and this stores ledger contains every variety of article fully detailed.

In the card system mentioned by Mr. Parker it is stated that (1) "all material received is recorded on cards which are filed and sent into the office daily where they are checked against the orders and invoices; (2) material is issued on receipt of card requisitions from the foremen, these cards also being filed and sent into the office every day; (3) the storekeeper having thus no clerical work to perform except on the receipt of material." It will be noticed here that the storeman would receive orders from the foreman, he would see that these orders were executed, but there is no mention of any record being kept of the quantity or weight of goods supplied to these orders. The foreman cannot fill in this data, and I think Mr. Parker must take it for granted that the storekeeper must have this clerical work to perform. The proposal he puts forward of a method for checking waste and carelessness on the part of a foreman would have the tendency to keep the foreman and storeman "at daggers drawn." This is not workshop management by any means, and a far better way is for the principals of a firm to revise the orders given out by the various foremen periodically. We instituted a book so that we might find out which men were wasteful in using oil, waste, tallow, and after keeping it in use for about a year and satisfying our needs, we gave it up. The same might be done for foremen. To charge out stores according to periodical fluctuations in prices would involve serious difficulties, and besides, would not be good business practice. The stores kept in an engineering establishment are really purchases in advance to meet requirements for contracts or other work, and these should be charged out against the various jobs they are supplied to at the rate at which they are



is much better to divide these in proportion amongst the contracts on hand, week by week, or fortnight by fortnight, as the pays occur. An oncost records book should be kept in which all oncost charges should be entered separately. The keeping of this oncost records book is really to enable any increase in any particular item to be looked into when it occurs, but it is well in the case of a book of this kind to avoid being too minute. The total oncost may be arrived at from a trades' ledger, where it may be split into a reasonable number of heads embracing, say, feu-duties, rents, taxes, or other similar items. In the trades ledger of a marine engineering shop a separate account should be opened for each contract, and one account to take in all jobbing or repair work. Each of these accounts should shew the material bought direct, the material taken from stock, and the labour spent upon the contract. The sum of these will shew the amount of material used in the course of a period, the amount of labour paid for, and the oncost accounts totalled together for the same period will shew the amount of oncost on the work done. This oncost will represent a percentage of the total material and labour, or of the total labour, and this figure over a number of years should be approximately the amount necessary to add for oncost when estimating for new work. In a balance sheet the oncost will appear on the debit side, and the difference between the total labour and material for each contract and the selling price will represent the gross profit on the credit side. The difference between gross profit and oncost will represent the actual profit or loss on the period's trading. The oncost on work in progress for balance-sheet purposes should be carried forward at the ratio of establishment charges actually incurred for the period during which the work is done, and this is easily arrived at from the trades ledger by taking the output, including work in progress, for that period and striking the percentage of oncost for the same period. The manner of charging oncost is unimportant, but it is preferable to do so with one percentage on material and wages or on wages alone, and upon no account can the system of splitting this figure into special factors be considered advisable.

On "Depreciation" Mr. Parker is very strong that machinery should be depreciated individually, and gives his reason for attaching so much importance to this in the next two sentences.

"Thus it is quite a common occurrence to find, in this country, machine tools in use twenty or thirty years old, firms being loth to part with them because their records do not shew that their individual values have been written off. If a record of each machine tool were kept, shewing the depreciation off every year, firms would be far more willing to get rid of old-fashioned and costly in upkeep machine tools." This is tantamount to saying that an engineering firm would not replace an old tool with a more modern one if the depreciation records did not shew that the old machine had been written off to its full value. The question of depreciation is one of book-keeping and nothing more. We have during the last three or four years thrown out something like a hundred machines and have never referred to book value when we proposed replacing them with new ones. We have thrown out machines ranging from six months to thirty years old, and we sold most of them by auction, so that no matter what we had depreciated them to, it would not have affected our purpose nor the price we realised for them in the very slightest. Mr. Parker does not look at this from a workshop manager's point of view, otherwise I imagine he would have modified his statement very much.

"Loose tools are a very important item, and the American plan of providing a tool room or branch store for their reception is beginning to be largely adopted in this country." Mr. Parker should have left out the word "American." If he were to visit 500 workshops in this country and 500 workshops in America he would find far more of the workshops in this country provided with tool rooms than in America, and he would also have found tool rooms in this country long before tool rooms were

takes the check with that number on it and replaces the article with it, and the liability of the storekeeper to place the checks in the wrong place is much more remote than for cards to be lost or not to be properly used. The method proposed of using cards, as in a library, for loose tools is too troublesome to be of practical use in a workshop. From an accounting point of view the method proposed, of writing off all additions and replacements each year and letting the value stand the same from year to year, is extremely loose, as in every establishment fluctuations in requirements frequently occur, and it is therefore advisable to have a regular yearly revaluation. I do not wish to take up much of your time in referring to the card system. We have now had a considerable experience in the use of cards and have adopted them in several directions in our works, and we have come to the conclusion that books are much superior to cards for all strictly book-keeping and also for final cost-keeping purposes. The best results are obtained by a judicious use of both systems. In our works every man is given a card on which is recorded the work he is required to do and his time allowance to do the job. This is written out in the rate-fixing department. When the work is finished the foreman examines it, and, if right, initials and records time of day upon the job card. The inspector also examines the work after it is taken out of the machine, and if correct, initials the job card. This is all the clerical work beyond writing out requisitions, which our foremen have to do, and the workmen have no clerical work. These cards are abstracted into a book—every operation on an article having a page to itself. We have, therefore, the records of the same operation on similar articles on one page, viz., time allowed, time taken, etc., and if we wish to get the cost of machining any piece of a marine engine, say a cylinder or a condenser, we can have it collected in a very few minutes. We recognise, by comparison with the previous times taken, how a man is progressing with his job, and if taking too long the matter is investigated on the spot. Instead of looking to slump figures, if our costs are low or excessive, we look to the details and watch them in progress.

In points to be considered in introducing a new system some of the books quoted by Mr. Parker are now what may be termed old books, so there has been no want of reliable information on the

subject during recent years. I question Mr. Parker's statement that these difficulties have been overcome in America any more than they have been overcome in this country. I do not think that any firm will ever be satisfied, or should ever be satisfied, with its present arrangements. I know from our own experience that changes should be made almost constantly, generally speaking, tending towards simplification.

Mr. Parker states that "all orders should emanate from one central source and that these orders should finally converge towards that same central source, and that this central source is, of course, the office." But something ought to have been said as to the manner in which this should be done. Orders may go through one book and the result may be shewn through another, but this is an inconvenient and somewhat clumsy method of making comparisons. The estimate, which is really the source, should be made on sheets and the costing system arranged in such a way that the final returns of costs will be entered on the same sheet and side by side with the estimate. We split up our estimates and costs for marine engines and boilers into nineteen sections, and the different items of material for each section are fully detailed, one entry being made for wages against each section, so that when a job is completed the quantities, weights, rates, etc., are shewn beside each other, item to item, estimate and cost.

On page 289 it is stated that "in using the collective order sytem, as described, the advantages are twofold; first, it enables the card to follow the part which it represents right through the shops, going to each man who has work to do on it, and serving the purpose of ordering everything in connection with it; second, it gives the cost in detail, so that when a similar job comes in

material in the works. A card is sent from the drawing office to the smithy and another one to the pattern shop authorizing work to be proceeded with, also to the counting house for material to be bought. When the smith has manufactured an article, he initials the card and passes it on to the engine works manager, who determines in which machine shop it is to be machined and puts it in the proper cabinet. The foreman of that department initials this card when he is finished with it and so on. The foreman patternmaker, when he sends a pattern to the foundry, initials his card and passes it on to the engine works manager, who directs the receiver of material to initial it when it comes into the works, if good, and also to put it into the cabinet of the foreman who is to machine it.

Mr. Parker has read to the Institution a most interesting paper. While there is a great number of points mentioned with which I do not agree, I take it that we have both had some experiences. There is no doubt that the subject is a most interesting one. Office work is generally interesting, but to manufacture cheaply, records of cost-keeping, etc., will not help any firm to do so when the workshop management is careless. I have been interested in this subject for a long time past, and am most pleased to have an opportunity of discussing and criticizing a paper of this kind at this Institution.

## MR. GEORGE PARKER'S REPLY.

Before dealing *seriatim* with the remarks made on my paper I should like it to be clearly understood that the methods dealt with are described simply from a general standpoint, no particular branch of engineering being in view, it being my endeavour to give as many known methods as possible of keeping workshop records by means of cards. Therefore some of the methods described, although of no use in a marine engineering establishment, are of value in other workshops.

In reply to Mr. MacColl I am sorry I am able to give him but little information as regards the cost of cost-keeping under the various methods I have described; but Mr. Cowan in his reply to the discussion on his paper on "Workshop Administration," read before the Institution of Engineers and Shipbuilders in Scotland, gives the cost, in an establishment where a card

system had been in operation for three years—the work being light, and the proportion of materials to labour 4 to 1—for keeping the general accounts of the establishment and the cost accounts of the work (costing about £30,000 per annum) as slightly over 1 per cent. on the cost of the work. There are several other interesting statements in reference to the card system in the discussion on the above paper.

As regards the old time-board system I am surprised that Mr. MacColl can have anything to say in favour of it, for however it may be used and whatever means be adopted to make it more accurate there is bound to be a large element of guesswork about the times recorded. Mr. MacColl objects to foremen using a ticket punch, but surely a hole punched in a card is much more accurate than initials made with a stubby piece of pencil, especially as foremen are not usually engaged for their ability as penmen. I quite agree with Mr. MacColl that a manager should always be on the look out for methods by which savings can be made, but unless he has accurate records with which to work he will often be unaware of losses which are being incurred every day.

In reply to Mr. Weatherall I should like to refer him to some of the papers given in Appendix I., page 291, of my paper, especially to the "Complete Cost Keeper," by H. L. Arnold, and the paper entitled "Cost-Keeping at the Chicago Works of Fraser & Chalmers," where he will find full descriptions of card cost-keeping systems in use by firms employing 1,000 to 1,500 men and making a great number of specialties. I am pleased to hear Mr. Weatherall condemn the board system, and as regards cards getting dirtied in their passage through the shops, this can be

major part of the literature on the subject "Workshop Records" is of American origin, but if he will refer to Appendix I. again and take the authors of the papers into consideration he will find that out of a total of eight books and seventy-two papers, only six books and twenty-four papers are by English authors, while there are two books and forty-eight papers by Americans; and if the amount and value of the information afforded be taken into account there is no comparison at all. I quite agree with Mr. Rowan that "How and where the cost of production can be reduced can only be satisfactorily answered by a combination of improved workshop management assisted by workshop records," but given two competing firms, one of which has good management but inaccurate records, and the other indifferent management but accurate records, the firm with the inaccurate records, despite its clever manager, will soon be put out of the market, provided, of course, that the quality of the work turned out is the same in both cases. In reference to "rough stores" and "finished stores" I again quite agree with Mr. Rowan that it is impossible to work a "finished store" in a marine engineering establishment, but the principle will be the same, for in all manufacturing establishments raw material should come in at one end and be gradually passed through the shops until it issues at the other end as a finished product, and the straighter this line of progress (all other factors being equal) the more economical the cost of production. As regards Mr. Rowan's method of dealing with raw material I should like to ask him how he is able to locate the whereabouts of every little casting and forging which comes in, if they are simply delivered on the shop floor in the vicinity of the machine which is to operate on them; and also in the case of many duplicate parts, how he is to prevent a workman helping himself when he happens to spoil a part.

I am sorry to hear Mr. Rowan say that he considers the subject, "Establishment charges," has been very much overrated by most writers, for in my opinion it is to the treatment of this item that the most attention must be paid in order to make the cost accounts accurate. Mr. Rowan goes on to say that "oncost or establishment charges should, of course, be reduced as much as possible by charging to the jobs in hand direct instead of to the oncost accounts." This is a most pernicious

practice and generally means that articles are charged out against a contract or job and are afterwards used on other contracts or jobs, the first contract or job bearing the whole charge; or the contracts or jobs are charged with some arbitrary proportion of the total charges each week or fortnight. Many firms by adopting this plan think they are reducing their establishment charges, whereas they are only increasing the cost of some contracts or jobs to the benefit of others. I am surprised that Mr. Rowan, as the avowed advocate of the premium plan in this country, should be satisfied with such a rule of thumb method of dealing with "establishment charges," especially as jobs taking a short period of time but highly paid skilled labour are burdened with the same percentage as jobs taking a much longer period of time and cheap unskilled labour.

As an accountant I should like to draw Mr. Rowan's attention to his use of the term "balance sheet." A balance sheet cannot show profit or loss, and the account wherein "oncost" would appear on the debit side would be either manufacturing account (as representing the whole output of a firm) or contract No. — (as representing any specific contract). As I said in my paper oncost is very often omitted in valuing work-in-progress for balance sheet purposes, but there is no reason why it should not be taken into account when it is scientifically dealt with. The method Mr. Rowan proposes is very far from being scientific, and I should not consider a balance sheet, with a large sum for work-in-progress (made up in this way) amongst the assets, as being a fair statement of the position of a firm. Mr. Rowan also evidently considers "depreciation" a subject of secondary importance and dismisses it as "a matter of book-keeping only,"

it is undoubtedly advisable to revalue the tools occasionally. As regards the "collective order system" Mr. Rowan says: "I am sure if the cards were going through five or six workmen's hands very little of the card would be left by the time it was returned to the rate-fixing department. Here again Mr. Rowan omits part of the method proposed, viz., the use of advice cards by means of which the collective order card need never go into the workmen's hands. I must also refer Mr. Rowan to my reply to Mr. Weatherall on this point.

I feel extremely indebted to Mr. Rowan for the time and trouble he has expended in criticising my paper, and I am sure all who are interested in the subject will agree with me that his remarks, coming as they do from one who has had so much practical experience of the card system, will be of great service to any of us, who may be contemplating the introduction of more modern methods, as showing some of the pitfalls to be avoided and difficulties which may be met with. At the conclusion of my paper I ventured to express the hope that this Institution might see its way to do something to promote the further study of the commercial side of engineering, for after all no one builds ships or engines for love, and the man who can do a given thing cheapest (everything else being equal) is the one who will come out on top. We have an engineering section and a shipbuilding section, why not a commercial section also? Then perhaps we would have more papers on commercial subjects and more discussion.

On the motion of the President a hearty vote of thanks was accorded by acclamation to Mr. George Parker for his valuable paper.

## DISCUSSION ON MR. R. P. LINK'S PAPER ON "CO-OPERATION AND MECHANICAL AIDS TO WORKSHOP COST-KEEPING."

Mr. ALF. HARRISON, speaking on Mr. Link's paper, said—I did not intend speaking on this paper but would like to make a few remarks. The writer startles us by introducing that most important subject on the social relations between masters and employees. All employers regret the ever-increasing difficulty of keeping in touch with their men. We recognise that the way to get the best out of our men is by getting hold of their hearts and I feel satisfied that the maximum of success will be with those employers who are in closest harmony with their men. The writer of the paper anticipated some difficulty on the part of the members in being able to connect this interesting problem with the question of "How to Keep Cost," and I do not see that any time-recording clock will help towards a better feeling between workmen and their employers. The unfortunate paragraph describing the workman starting his work suggests that consideration for the workman had better not have been entertained.

The main portion of the paper is a comparison between time-recording clocks and the old-fashioned time-boards. For thirty-two years we have been working on a cost-system by which the whole of the work on a set of engines and boilers, from booking the order to delivering the machinery after trial at sea, is divided into about eighteen sections distinguished by schedule letters. A separate cost-book is kept for each contract and the costs are posted in such a way that the actual cost of labour and material can be seen at any time during the progress of the work. On completing the work a cost analysis sheet shewing details of each separate section is prepared for every contract, so that we can compare any section with the results of other similar or duplicate jobs, and should there be any differences they can be localised and explained easily. When we require costs of small details, we issue a special number and follow the job carefully through the

shops. After thirty-two years' working with this system it still appeals to me as being simpler and better than any card system I have seen. After visiting a number of works in Scotland to enquire into this system I came away feeling that it was far too elaborate and that it was not necessary to be constantly repeating throughout the whole year the cost of a large number of duplicate parts, when the occasional cost seems to be all that is required for useful purposes. I am glad to hear Mr. Rowan's excellent remarks to-night and am not surprised to find that some of these methods which I saw in operation were not so useful as the people represented, in fact, in some of the works they had been dropped.

As to the time-recording clocks, I do not see any necessity for a man having to enter as far as a dozen jobs on his time-board. Our average number of entries is three and a half and I see no reason why a man should not be given as much work of one kind as will keep him going half a day. Our system of time-keeping is as follows:—Every time a man starts work he draws a check with his number on at the time-office and drops it into the time-office again. After all men are in and the doors closed the timekeeper enters the numbers of the remaining checks into a book so that a careful record is kept of all absentees. After the day's work is done the time-boards are filled up by the men and dropped into the time office when leaving. The night watchman sorts them into certain groups corresponding to each class of men employed, and after the works are started next morning each group is carefully gone over by their foreman or chargeman and if correct they are initialed and handed to the time-keeper who enters them into his time-book. We have a separate time-book for every week's pay. We pay 500 men in seven

## CLOSING BUSINESS.

The meeting then proceeded to transact the customary closing business of the session.

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## APPOINTMENT OF AUDITORS.

Mr. J. R. FOTHERGILL—I have pleasure in proposing that Messrs. R. W. & J. A. Sisson be re-appointed auditors. They have been our auditors for many years, I think since the Institution commenced, and they have given every satisfaction. The Council has been completely satisfied with their balance sheets. Therefore I have great pleasure in proposing their re-appointment.

Mr. J. H. HECK—I have very much pleasure in seconding that.

The proposition was carried unanimously.

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## THE NEW COUNCIL LIST.

The PRESIDENT—The result of the balloting on the list of vacancies in the Council is as follows:—

*President*—Mr. John Tweedy, J.P., (Messrs. Wigham Richardson & Co.), Newcastle-upon-Tyne.

*Vice-Presidents*—Mr. G. H. Baines and Mr. W. C. Borrowman (Central Marine Engine Works), West Hartlepool; and Mr. Ernest H. Craggs, Shipbuilder, Middlesbrough.

*Honorary Treasurer*—Mr. G. E. Macarthy, Newcastle-upon-Tyne.

*Members of Council*—Mr. James M. Allan (Messrs. Hawthorn, Leslie & Co.), St. Peter's Works, Newcastle-upon-Tyne; Mr. George Clark, Southwick Engine Works, Sunderland; Mr. George Jones (Messrs. Sir William Gray & Co.), West Hartlepool; Mr. J. R. Perret (Elswick Shipyard), Newcastle-upon-Tyne; and Mr. J. L. Twaddell (Messrs. Palmer's Shipbuilding Co.), Jarrow-on-Tyne.

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## INSTALLATION OF NEW PRESIDENT.

The PRESIDENT (Mr. Henry Withy)—The next business is the installation of our new President. I am sure you will all be very pleased with the appointment of Mr. John Tweedy, and all know that he will be able to carry on the business of this Institution with the greatest ease and pleasure. I have told him what hearty support the President is certain to receive from the members and from the Council—perhaps I might say especially from the Council—and I am sure we all hope that he will have a happy time of office and not find the labours at all a burden to him. There is not very much more business to do to-night, but it is for the new President to take the chair. I therefore now ask Mr. Tweedy to take the chair.

Mr. Tweedy took the chair amid hearty and general applause.

The PRESIDENT (Mr. John Tweedy) said—I thank you very much for the honour you have conferred upon me in placing me in the position of President of this Institution. I scarcely think you have been so happy in your choice this year as you were two years ago when you elected my predecessor. It is a comfort, however, to know from Mr. Withy and other predecessors in the chair that the Council are so indulgent and so generous in the assistance they give to their Presidents, and I hope, if they will continue that indulgence a year or two longer, the Institution will not suffer during the time I occupy this position of President.

second to none, and I specially desire our thanks to him should include our appreciation of his constant and regular attendance in the chair, not only at our General Meetings, but equally at our Council Meetings.

The work of the President is more in the Council than at the General Meeting, and occasionally when knotty points come forward affecting the well-being of the Institution the Council look to the President for guidance, and it is with satisfaction I say Mr. Withy has the kind thoughts and feelings of every member of the Council for the practical common-sense manner in which he has conducted the business of the Council. Although we much regret losing Mr. Withy as President, yet the rule that after a certain term of office the President must retire is undoubtedly a wise one and to the best interest of the Institution.

Our new President will find the Council a very democratic body, but always ready and willing to have their President's views and guidance. There is one feature of the Council most gratifying, and I can speak with some authority having been a member of the council for fourteen years, and that is, there never has been any form of cliquism, each one has only the Institution's interests at heart and this materially lessens the difficulties of the chair. I do not think it is necessary for me to enlarge upon Mr. Withy's capabilities in the chair. You all know him and you have all met him. You have heard him at our various meetings and you will bear me out in saying he has been a chairman whom it will be very difficult to keep abreast of. Allow me to say one word on behalf of the Hartlepools' members:—We were all very proud when Mr. Withy was elected President and we are all very satisfied and pleased with the manner in which he has filled the office.

I now ask you all to give a very hearty vote of thanks to Mr. Withy for the very capable manner in which he has filled the chair during his term of office.

Mr. R. H. Muir—I have very great pleasure in seconding the vote of thanks proposed by Mr. Fothergill. I think I can say for the members, as I am perfectly certain I can say for the Council, that we part with Mr. Withy with regret. He has filled the chair at our meetings with the utmost satisfaction to every member, and that is saying a good deal. Our President

has fulfilled every duty that was asked of him. He was a little bit diffident and shy of coming into the chair, but he has had some pleasure, as well as given us pleasure, during the time he has occupied that position.

Mr. J. H. Heck -I should just like to say a few words. I have been a member of the Council for some years and a member of the Institution since it started, and I have known most of the Presidents that have been here, but during the time I have known Mr. Withy I consider him a President among Presidents.

The motion was carried with cordial acclamation.

Mr. Withy—I hardly know what to say in reply to all these flattering remarks. I have told you before it has been a very pleasant time to me while I have been in office, but in any case the two years' labour has been amply repaid by your very hearty vote of thanks to-night.

## THANKS TO RETIRING MEMBERS OF COUNCIL.

Mr. John Walker was asked to propose a vote of thanks to the retiring members of the Council. He said—I feel highly honoured by being called upon to propose this vote of thanks. I think I am peculiarly fitted—more than some other members of this Institution—for the duty I am asked to perform, because it was my high distinction, on one occasion, to be a member of the Council of this Institution. Consequently, being well

ing members of Council. There is no doubt there is a lot of work done which the ordinary members are unaware of. There are many meetings to attend, and many sacrifices to be made by a Council man, and I think our thanks are due to them for the way in which they have carried out the work.

The motion was heartily carried.

The PRESIDENT—I have the formal duty now to perform of declaring that this session is closed. I hope we will meet again in the autumn, refreshed by our summer holiday.

The meeting then dissolved.

DINNER.

to the works vehicles were in attend-
tors to the Cutlers' Hall, where, at the
Cammell & Co., dinner was served. Mr.
managing director, received the guests,
. He was supported by Mr. John
Institution, on the right, and Mr. F. C.
ing directorate of Messrs. Cammell & Co.,
also present: Mr. Henry Withy, Past
Fothergill, Vice-President; Mr. W. C.
ident; Mr. J. M. Allan, Member of
Macarthy, Hon. Treasurer; Mr. John
and about 200 members of the Institution.

on the conclusion of the repast, said—We
our it will not tax your patience. The first is
all honour, but will doubly do so in view of
which all of us have borne during the last few
the health of the first personage in the realm.
is now pronounced to be out of danger, and
my heart what I am sure you will receive with
and the other members of the Royal Family."

drunk with musical honours.

said—The next toast is one which almost
to us, concerned as we all are in our defences.
has done in South Africa is an index of what
doing if called upon to serve this country in other
globe. What the navy could do is a question of
I am certain that we all of us are sure that if the
navy were required it would be equal to all the
that could possibly be made upon it. With regard to
branch—the volunteers—if it should so happen their
needed we are equally confident they would hasten
and play their part as becomes Britons in the defence
country. As there is some little stress upon our time I
longer, and I would ask Captain Martin, of

but it is not often such an ingot is required. Ordinarily they make them up to 70 tons or 75 tons, for crank shafting. Although when finished the crank shafts do not weigh that much, it is necessary to cast that amount of steel to allow for waste in the various processes which follow in the development of the finished article. The ingot under notice was large enough, however, to impress the visitors. Passing on, the visitors witnessed the manufacture of steel shells, and also of steel tyres, the latter being for Midland Railway carriages. The process of converting a square block of metal into a carriage tyre, finished all but the turning and boring, was novel to many present and was followed with great interest. The forging of an armour plate slab under the 6,000 tons hydraulic press was next seen. The slab weighed 35 tons, and is intended for the citadel of the "Commonwealth." Another interesting operation was the forging of a large shaft for H.M.S. "Devonshire," one of the new cruisers, under 2,500 tons hydraulic pressure. The apparent ease and absolute effectiveness with which these huge pieces of steel were manipulated was admitted to be remarkable. The manufacture and testing of springs, buffers and other accessories of a railway train formed another feature of these shops, after which the party re-entered the train and were conveyed to the Cyclops works (west forge) where they arrived at about half-past two. Here again was witnessed a further process in the development of an armour plate of great thickness. It measured 19 feet by 8 feet 9 inches, and was rolled down to a thickness of 9 inches. The carburising and sprinkling of these plates, the hydraulic bending press for bringing them into exact and proper shape, and the finishing shops all formed matters of extreme interest to the visitors. The Cyclops steel works were next entered, the ingot-

## THE DINNER.

At the main entrance to the works vehicles were in attendance, and conveyed the visitors to the Cutlers' Hall, where, at the kind invitation of Messrs. Cammell & Co., dinner was served. Mr. A. G. Longden, the senior managing director, received the guests, and afterwards presided. He was supported by Mr. John Tweedy, President of the Institution, on the right, and Mr. F. C. Fairholme, of the managing directorate of Messrs. Cammell & Co., on the left. There were also present: Mr. Henry Withy, Past President; Mr. J. R. Fothergill, Vice-President; Mr. W. C. Borrowman, Vice-President; Mr. J. M. Allan, Member of Council; Mr. G. E. Macarthy, Hon. Treasurer; Mr. John Duckitt, Secretary, and about 200 members of the Institution.

The CHAIRMAN, on the conclusion of the repast, said—We have a toast list, but it will not tax your patience. The first is one which you will all honour, but will doubly do so in view of the load of anxiety which all of us have borne during the last few weeks relative to the health of the first personage in the realm. Happily, the King is now pronounced to be out of danger, and I give you from my heart what I am sure you will receive with me—"The King, and the other members of the Royal Family."

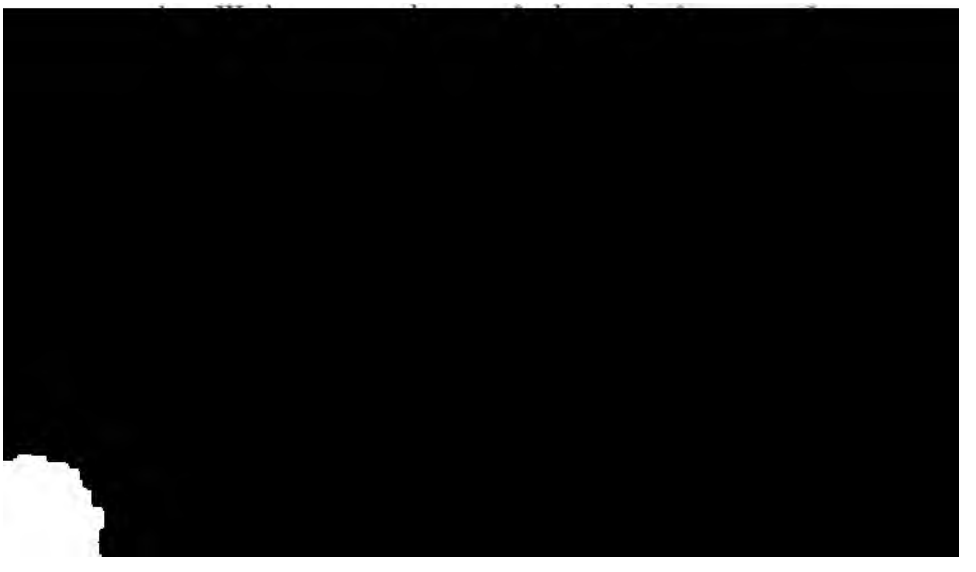
The toast was drunk with musical honours.

The CHAIRMAN said—The next toast is one which almost equally appeals to us, concerned as we all are in our defences. What the army has done in South Africa is an index of what it is capable of doing if called upon to serve this country in other parts of the globe. What the navy could do is a question of belief, but I am certain that we all of us are sure that if the services of the navy were required it would be equal to all the demands that could possibly be made upon it. With regard to the other branch—the volunteers—if it should so happen their services were needed we are equally confident they would hasten to the fray and play their part as becomes Britons in the defence of their country. As there is some little stress upon our time I need not detain you longer, and I would ask Captain Martin, of

the Royal Engineers, to be good enough to respond on behalf of the Army and Navy, inasmuch as Mr. Manning, of the Royal Navy, has been prevented from being with us this evening.

Captain J. MARTIN, R.E., said—In response to the toast of the Army, Navy and Volunteers, I think I had better refer you to the press. As a rule it gives a very fair account of the doings of the army and navy and volunteers. As regards the army, I think the past deeds in South Africa tend to show that they still retain the dash and courage as of old. As regards the navy, I think what they did in South Africa shows that they are quite as capable of fighting on shore as on the water. And as regards the auxiliary forces, I think they have proved themselves capable of standing shoulder to shoulder with the regulars. I am quite sure their duties have been made much more pleasant by the kind assistance of the civilian population of the British Isles in rendering to them, their wives and families, the financial assistance which they have done, and I feel it is a kindness they will never forget.

Col. BINGHAM, also called upon to respond, said—If this toast needs some one to strengthen it in the response I think a Colonel here of the name of Woodman, who has been to the front, should have addressed you. As to the army, it is really going through the same phase again. The regular army are engaged to fight our battles, and they do it. The volunteers have the praise of being volunteers, and they have done it. As to the fleet, it is a specialty, I think, of our own. We know what the handy man



Mr. FAIRHOLME said—I have the very pleasant task of proposing the health of the members of the Institution who are our guests this evening. As Mr. Longden has remarked, time presses, and therefore I will not do more than express the very great pleasure which my colleagues of Messrs. Cammell & Co. and myself feel in welcoming the members of an Institution which is representative of industries so closely allied to our own, and in which we cannot fail to have considerable interest. I have great pleasure in giving you the toast of "The North-East Coast Institution of Engineers and Shipbuilders."

Mr. JOHN TWEEDY, President of the Institution, said—I am sure I only express the wishes of those present when I thank you for the great kindness you have done us in allowing us to see your magnificent works to-day, and especially for the handsome entertainment that has followed that visit. I am sure we must all have derived very great benefit from seeing these large works, and seeing the facility with which huge masses of steel are manipulated. We are all acquainted with the launching of large steamers, but I doubt if we are so well acquainted with seeing launched a huge armour plate. We could not pass through the works without seeing that Messrs. Cammell had put themselves to great inconvenience and considerable expense for the purpose of bringing together interesting operations just at the right moment, and I think that alone deserves our heartiest thanks. I am told that time presses, and I must conclude by thanking Messrs. Cammell & Co. for the great kindness they have done to us, and the great technical and physical benefit they have given us.

Mr. HENRY WITHY, Past President, said—Almost the best toast has been reserved to the last. It has been given to me to propose a vote of thanks to Messrs. Cammell & Company for their great kindness in throwing open their works to-day. We have paid many visits of this kind before, but I am sure none have been more interesting to us than to-day's proceedings. We are all accustomed to see operations of the nature of those which we have seen to-day, but the magnitude is the difference. Our operations are comparatively small, and I am sure we must all have learned a great deal from the very fine machinery and appli-

ances we have seen. As this is the last toast I am privileged to put it in very few words—"Messrs. Cammell & Company."

The toast was very cordially honoured.

The CHAIRMAN said—On behalf of my colleagues and myself I thank you most sincerely for the way in which you have received this toast. It has been a pleasure to my colleague in the managing directorship, Mr. Fairholme, and all associated in the control of what I may call a vast establishment, to open our doors to-day and to show you what can be seen within the walls of the works, or part of the works, of Cammell & Company. You have not seen them exactly in the shape in which we might have allowed you to have viewed them, because we are not so busy as we have been, and we are to some extent suffering from the falling away in business which is before us. You gentlemen connected with shipbuilding are too well aware that your industry is threatened with invasion, and the steel industry is threatened in the same fashion. Let us hope we will all stand together and mutually help each other, and if we do so I think it will be found that old England is not yet done for, and that in years to come we will still manage to hold our own as we have been able to do in years past. I thank you very much. It has given us great pleasure to have you with us to-day, and I hope it will not be your last visit.

Mr. TWEEDY said—The organization of this most interesting trip is mainly due to Mr. Duckitt and Mr. Hodges. Before separating I think we should certainly thank these gentlemen for their work in this matter, and say how much we appreciate their labours.

The proposition was received with cheering, the health of Mr. Duckitt and Mr. Hodges being drunk.

Mr. DUCKITT said—There seems to be some misunderstanding with regard to this toast. I do not know how it has occurred, but I believe the toast was to have been the health of Mr. Hodges, yet my name is connected with it. With regard to this trip, I was approached by the representative of Messrs. Cammell & Company, and they kindly invited us to come here. So far as the greater

part of the arrangements is concerned, they have been in the hands of Mr. Hodges. In regard to what I have had to do, well, it has been a light piece of work, while I am very much afraid Mr. Hodges has found it has caused him a good deal of labour. I thank you for the way in which you have received the toast.

Mr. Hodges bowed his acknowledgments to the company.

This concluded the formal proceedings.

The company then drove to the Midland Railway station and left by special train at 6·40 p.m., reaching Newcastle-upon-Tyne shortly after eleven o'clock.

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## EXTRACTS FROM THE HISTORY OF THE FIRM OF MESSRS. CHARLES CAMMELL & CO., LIMITED.

The Company was established in the year 1837 by the late Mr. Charles Cammell in partnership with Mr. Thomas Johnson and they traded as Johnson, Cammell & Co., Steel and File Manufacturers, Furnival Street, Sheffield. Just about this time the railway systems of England, the Continent, America and elsewhere were undergoing great changes and were being developed with marvellous rapidity, thereby putting within the reach of iron and steel manufacturers such an opportunity of extending their business as had never before occurred. The firm took advantage to the full of the changed order of things, and their undertaking expanded with extraordinary rapidity. Increased accommodation became absolutely necessary, and experience had already shown the importance of being in touch with the local railway systems and through them with the outer world, so that the raw materials might be more readily and economically received, and the finished work more easily and promptly despatched. A plot of land covering eleven acres was secured in Savile Street, adjoining the Midland System, and upon it the now far-famed Cyclops works were erected (see Plate XXXI.). They were entered upon in 1845, and with increased facilities for production the scope of the firm's operations rapidly extended.

In 1852 Mr. Johnson died, and Mr. Edward Bury, then locomotive engineer of the London and Birmingham Railway, was received into partnership as his successor. Three years later Mr. Bury retired and the firm became "Charles Cammell & Company." The business was converted into a Limited Company in 1864. Mr. Cammell was appointed chairman of the Company and Mr. George Wilson, who had some years previously joined the concern, became managing director. When Mr. Cammell died, in 1879, Mr. George Wilson was elected to the position of chairman. He occupied both offices with considerable ability, and with great advantage to the Company until his somewhat sudden death in 1885. He was succeeded in the chairmanship by Sir Henry Watson, J.P., D.L.; and as managing director by his brother, Sir Alexander Wilson, Bart., J.P. An incident illustrating Mr. George Wilson's shrewd business foresight may be mentioned. In 1880 and 1881, finding there was no prospect of securing a reduction in railway charges, and that the competition of rail-making firms was becoming increasingly keen, he urged the establishing of works for their manufacture on the Cumberland coast, a place within a few miles of extensive ore-fields, where there was ample harbour accommodation; and whence their production could be sent to Liverpool by sea at less than half the cost of railway rates. His suggestions were carried out and proved an entire success. When Sir Alexander Wilson, the present Chairman, came to the Cyclops works it was a private undertaking, employing some five hundred people. He has seen it develop into one of the most gigantic concerns of the world, having a capital of over one million pounds sterling and employing upwards of ten thousand men. In bringing about this marvellous progress Sir Alexander Wilson has taken a very active and prominent part. With the armour-plate industry his name is indissolubly associated. Prior to the rolling at the Cyclops works, in 1862, of the first iron plate, he had given his closest attention to the subject of armour for battleships, and in 1876 he introduced the "Wilson Compound Plate," which for so many years, notwithstanding the severest tests, held the field against all other inventions. Indeed it is only in quite recent years that it has been improved upon. It has already been stated that the Cyclops works were commenced early in the forties. They were extended as the business prospered until the utmost

limit was reached. At the present time they are devoted to the manufacture of armour plates, axles, tool steel, files and all kinds of small forgings. In them is also the crucible steel plant. More accommodation being needed to meet the growing connections of the Company, the Yorkshire Steel and Iron Works at Penistone were acquired in 1864. In them is carried on the manufacture of steel rails, railway, locomotive, carriage and wagon tyres and axles, locomotive crank axles, shafting of all descriptions, marine crank and straight shafting, piston and connecting rods, and forgings for all purposes and of all weights up to twenty tons. Even with this important addition to their means of production the Company were still cramped for room, and commodious works were erected at Grimesthorpe (see Plate XXXI.). Here they have their large hydraulic forging press and Siemens-Martin steel plant, and here they produce steel forgings and castings of any size and weight up to 120 tons. It is worthy of note that Messrs. Cammell & Co. were the first to introduce in England the system of forging steel ingots by hydraulic pressure. This was in 1863. In 1882 the Company purchased the Derwent works at Workington, in Cumberland, where they are manufacturing steel rails through all stages, from the ore to the finished rail. The Old and New Oaks Collieries were purchased in 1872 and the Company are able to furnish their works with an ample supply of the finest quality of coal from their own pits.

# MEMOIRS.

## MR. MAGNUS SANDISON.

The late Mr. MAGNUS SANDISON was born at Highlaws, Berwickshire, on the 6th Setpember, 1857. He was the eldest son of Mr. Magnus Sandison of Caithness, who in his day did much useful work in building sections of the Waverley and East Coast railway routes. After his father's death he resided with his maternal grandfather, the late Rev. William Munro of Hawick, where in 1867 his schooldays began. From Hawick he was sent in 1869 to Penrhyn House School, Birmingham; his first glimpses of Newcastle being on passing through on his various journeys there. From Birmingham he proceeded in 1872 to the Madras College, St. Andrews, from which, after a thorough grounding, he entered the United College of St. Salvator and St. Leonard's, completing his academical course therein. His engineering training began in the Anchor Line engine works, Glasgow, where in 1875 he signed articles for a six years' apprenticeship, the latter part of which was passed in the drawing office, wherein he gained much experience in designing and fitting up machinery in connection with the Bell Coleman Dry Air Refrigerator. During this period he was a regular attendant and very successful student at the classes conducted by Mr. W. J. Millar, C.E., and Professor Rowan.

On his return in 1884 he was appointed Superintendent Engineer for the Elswick shipyard of Messrs. Sir W. G. Armstrong, Mitchell & Co., after sixteen years in the service of which firm he met his untimely end. The loss of H.M.S. "Cobra" and the death of Mr. Sandison are too well known to the members of the Institution to need recapitulation. Suffice to say that on the evening of the 17th September, 1901, the vessel left the Tyne for Portsmouth, encountering very bad weather throughout the night. About seven o'clock the following morning, when about thirty miles off the coast of Lincolnshire and near the Outer Dowsing lightship, a shock was felt throughout the vessel, within a few minutes of which she parted amidships and sank. The rapidity with which the vessel settled down and the roughness of the sea allowed of only the dinghy being successfully launched, and the "Cobra" disappeared, carrying with her Mr. Sandison, Mr. Robert Barnard, who was also a member of this Institution and who represented Messrs. Parsons Steam Turbine Works, the Commander, Lieut. Alan W. Bosworth Smith, and 64 men. The dinghy, containing the chief engineer and 11 men, succeeded after great danger and privation in reaching Middlesbrough in safety.

The Elswick firm furnishes the following statement of his sixteen years' connection with them:—

"Between 1884 and the present time, nearly one hundred war vessels of every class have been built at Elswick, and the machinery for each of them has been constructed under the supervision of Mr. Sandison, who represented Mr. Watts and the Elswick firm in all questions relating thereto.

"The vessels built during Mr. Sandison's connection with the firm included:—1st class battleships of the largest tonnage and power for the British and foreign navies. A number of 1st class armoured cruisers of exceptional power for the Government of Japan. Several very swift protected cruisers for the Governments of Chili, Argentina and Brazil, in addition to a number of cruisers for the Chinese Government.

"A number of smaller vessels of varying types were built at Elswick and engined there during Mr. Sandison's term of office, including:—

The British cruisers "Sirius" and "Spartan."
The Australian cruisers "Katoomba," "Mildura," and "Wallaroo."
The British torpedo gunboats (composite) "Rattler" and "Wasp," built for service in the China seas.
The British torpedo gunboats "Swordfish" and "Spitfire," each of 27 knots speed.
The Australian cruisers "Panther" and "Leopard" (which were the first two vessels of war built at Elswick).
The Indian gunboats "Plassey" and "Assaye," each of 27 knots speed.

"Among the larger and more important vessels may be mentioned:—

The British battleship "Victoria" of 10,400 tons displacement.
The Japanese battleship "Yashima" of 12,300 tons and 19¼ knots speed.
The Japanese battleship "Hatsuse" of 15,000 tons and 19 knots speed.
The Japanese first class armoured cruisers "Asama" and "Tokiwa," each 9,750 tons and 23 knots speed; "Idzumo" and "Iwate," each 9,750 tons and 23 knots speed.
The Argentina cruisers "*9th July*" and "*25th May*" of 3,500 and 3,300 tons and 22¾ and 22½ knots speed, respectively.
The Chilian armoured cruisers "Esmeralda" of 7,000 tons and 23 knots speed, and "O'Higgins" of 8,500 tons and 21½ knots speed, as well as the Chinese cruisers "Hai Chi" and "Hai Tien" of 4,500 tons and 24 knots speed.

"We shall not be far wrong in stating that Mr. Sandison was present at every trial carried out by these and many other vessels built at Elswick.

"The whole of the machinery used in building their vessels at Elswick shipyard was under the care and supervision of Mr. Sandison, who, throughout his sixteen years of service, enjoyed the good will and esteem of the whole of his colleagues."

The question of the economical propulsion of warships at low

Mr. Sandison was one of the earliest members of our Institution and always took a keen interest in its success. In 1886 he contributed, along with Mr. James Paterson, a paper on "Forced Draught," and later in 1890 another on "Main Steam Pipes," both of which were well received and elicited good and useful discussions.

His death was universally regretted by all who came in contact with him and much sympathy is felt for Mrs. Sandison and her four children.

## MR. ROBERT BARNARD.

Mr. ROBERT BARNARD, who lost his life in the ill-fated "Cobra," was the manager of Messrs. Parsons Turbine Co. He was a naval architect and engineer of unquestioned skill. He came to Tyneside from the south of England, and assisted in the designs of the "Turbinia," superintending her construction. Next to the inventor himself, he contributed most eagerly to the success of the vessel during her trial. He became manager when the pioneer company was merged in the present company, and superintended the erection of their works at Wallsend. He supervised the construction of the "Viper," the "King Edward," and also the "Cobra." Mr. Barnard was a firm and enthusiastic believer in the possibilities of the turbine. He became a member of this Institution in 1899.

## MR. R. C. C. HAMILTON.

The late Mr. ROBERT CHARLES CLEMENTS HAMILTON was the second son of the Venerable George Hans Hamilton, D.D., Archdeacon of Northumberland, and the Lady Louisa Hamilton. He was born at Eglingham Vicarage on the 15th of May, 1871. After completing his education at Repton School he spent three years in the engineering works of Mr. Robert Thornewill, Burton-on-Trent. At the end of this period he entered the employment of Messrs. Wigham Richardson & Co., Neptune Works, Low Walker-on-Tyne. Subsequently he was employed by Messrs. Sir W. G. Armstrong, Mitchell & Co. in their works at Naples. At the commencement of the South African War he joined the Elswick Battery of volunteers and started for the seat of war. Early in the summer of 1901 he returned home to England greatly shattered in health after the many hardships

he had undergone. His last and fatal journey was undertaken in the autumn of the same year, when he set sail on board the s.s. "Para," bound for the West Indies. The "Para" had been fitted with a new appliance for preserving fruit on the voyage, and Mr. Hamilton was employed as engineer under the inventor, Mr. Lawton, who was also on board. When off Jamaica and whilst at sea there was an explosion which killed the inventor, Mr. Hamilton and another outright and wounded several others. This occurred on the 21st of November, 1901.* Mr. Hamilton joined the Institution as a graduate in 1892 and entered the members' section in 1895.

## MR. WILLIAM HENRY SCOTT.

The late Mr. William Henry Scott was one of the best known and esteemed figures in the commercial life of Tyneside. He was the head of the firm of Messrs. Scott Brothers, Limited, coal, chemical and metal merchants, of Newcastle-upon-Tyne, and had been connected with the trade of the Tyne for more than half-a-century. He was, indeed, widely known as the "Father" of the Quayside, and was everywhere beloved for his courtly manners and genial disposition. He resided at St. Oswin's, Tynemouth, where he passed away on Saturday afternoon, August 16th, 1902, with some degree of suddenness, for although he had not been in good health since the beginning of the year, following upon a serious illness, he had recovered sufficiently to be able to journey frequently to his business in Newcastle, and was, in point of fact, at his office four days before his death. The deceased did not take any active part in public affairs—so far, at any rate, as serving on representative bodies is concerned, but on more than

## MR. EUSTACE SMITH.

Mr. EUSTACE SMITH, who was born in 1861, was the second son of Mr. Thomas Eustace Smith, late M.P. for Tynemouth; grandson of Mr. William Smith, of the firm of Messrs. Thomas and William Smith, and great-grandson of Alderman Smith of Heaton Hall. He was owner of the St. Lawrence Ropery—a business established by one of his ancestors in 1781. Under his guidance and enterprise this business has of late years been greatly developed, the manufacture of steel wire rope being carried on on a very large scale.

In 1881 he joined the firm of Messrs. T. and W. Smith of North Shields. At that time the firm possessed a large shipbuilding yard and one dry dock. This firm was latterly merged into the firm of the "Smith's Dock Co.," and Mr. Smith became the managing director.

As managing director he joined with the firm of Messrs. H. S. Edwards & Sons, of South Shields, the amalgamation of the two dry-docking concerns being effected under the auspices of the Smith Dock Company by Mr. Smith a few years ago. A year or two ago, he acquired the shipyard and business of Messrs. Edwards Bros. and at the same time extended the shipbuilding premises of the Smith Dock Company in North Shields for the building of steam trawlers and herring drifters; and the combined concerns were merged under the title of the "Smith Dock Company," which is now one of the largest producers of this class of craft in the country, turning out from 20 to 25 steam trawlers and herring drifters per annum.

The steam herring drifter was an innovation in which Mr. Smith took a particular interest. It was the necessary consequence of the substitution of steam for sailing craft in the fishing trade, and during the last two or three years in particular the yards of the Smith Dock Company have turned out quite a quantity of this type of fishing craft which, we understand, proved very successful, and well adapted to the purpose intended.

The deceased gentleman was a most energetic and enterprising man, and the many improvements and additions which have been carried out in connection with the firm are mainly attributable to his fine business capabilities. He was of a most courteous and genial disposition, and was always very popular with his workmen.

While on a visit to London he was taken seriously ill with a severe attack of pneumonia, to which, after about three weeks' illness, he succumbed on the morning of Saturday, June 14th, 1902.

He was one of the earliest members of this Institution, having joined when it was founded in November, 1884.

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## MR. GEORGE RUTHERFORD.

Mr. GEORGE RUTHERFORD was born at Newlands, Peebleshire, in 1855.

In 1870, he was apprenticed to Messrs. A. & J. Inglis of Glasgow and in 1876 went to Japan as manager of the Kobe Iron Works.

Returning home in 1881 he superintended the building of two steamers for Messrs. "The Queenslands Steam Shipping Company" afterwards being appointed general manager of branch works then being erected at Cardiff by Messrs. The Wallsend Slipway and Engineering Company.

These works were in 1887, enlarged by the addition of a Pontoon Dry Dock and formed into a separate Company of which Mr. Rutherford retained the management.

After a short severance of his connection with the Pontoon, during which time he was general manager of the Messrs. Bute Shipbuilding and Engineering Company of Cardiff, he obtained control of the former Company, which was re-organised as the Mercantile Pontoon Company, with Mr. Rutherford as managing director.

This position he held until the close of the year 1901, when the interests of the company were merged into those of Messrs. The Bute Shipbuilding and Engineering Company at a very hand-

*Speed of Machine Shop Tools."*

TEST I.—ON HARD STEEL SPINDLE, 60 TON QUALITY.

9 SAMPLES OF TOOL-STEEL.

DURATION—FROM 1 TO 2 HOURS.

SPEED—8 FEET PER MIN.

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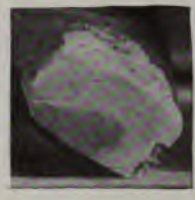
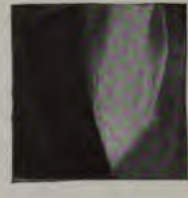
| " |  | |
| " | |  |
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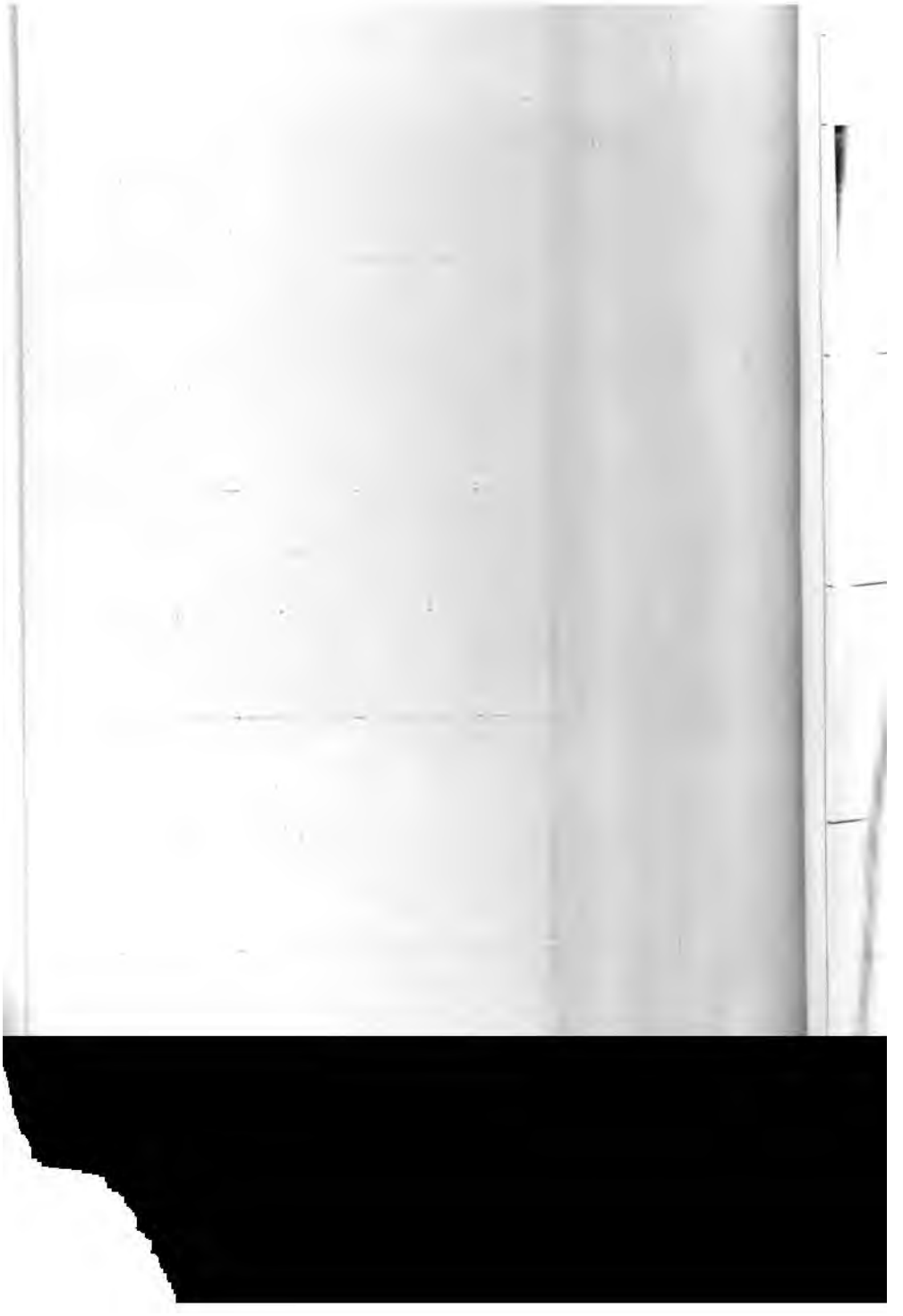

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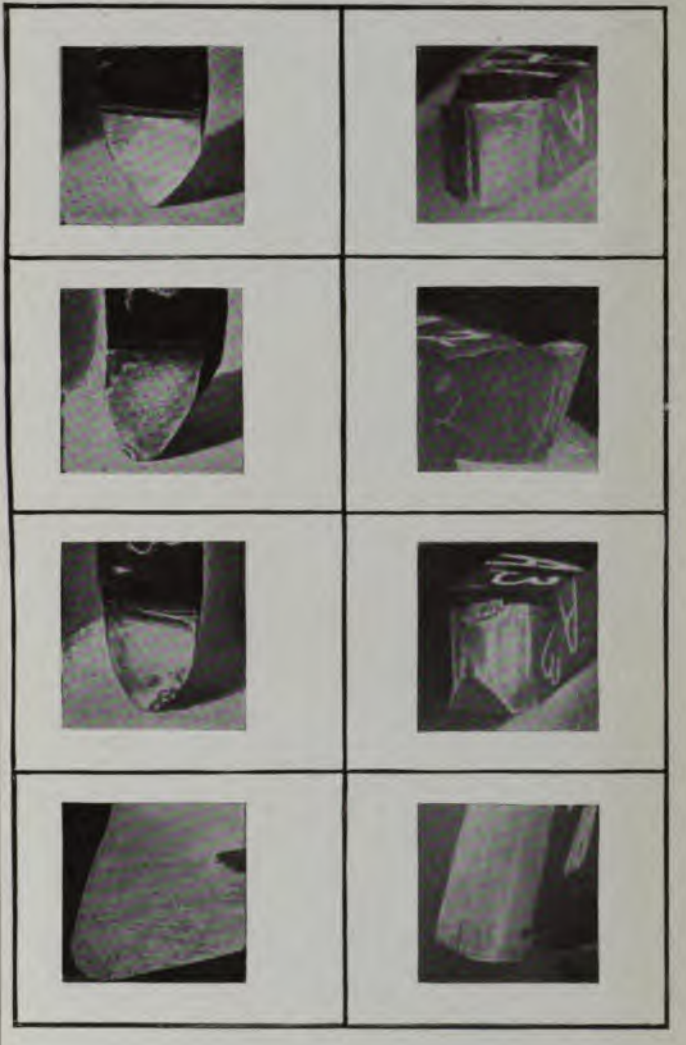
TEST II.—ON HARD STEEL SPINDLE, 40 TON QUALITY.
DURATION— FROM 3 TO 25 MINUTES.
SPEED—16 FEET PER MINUTE.



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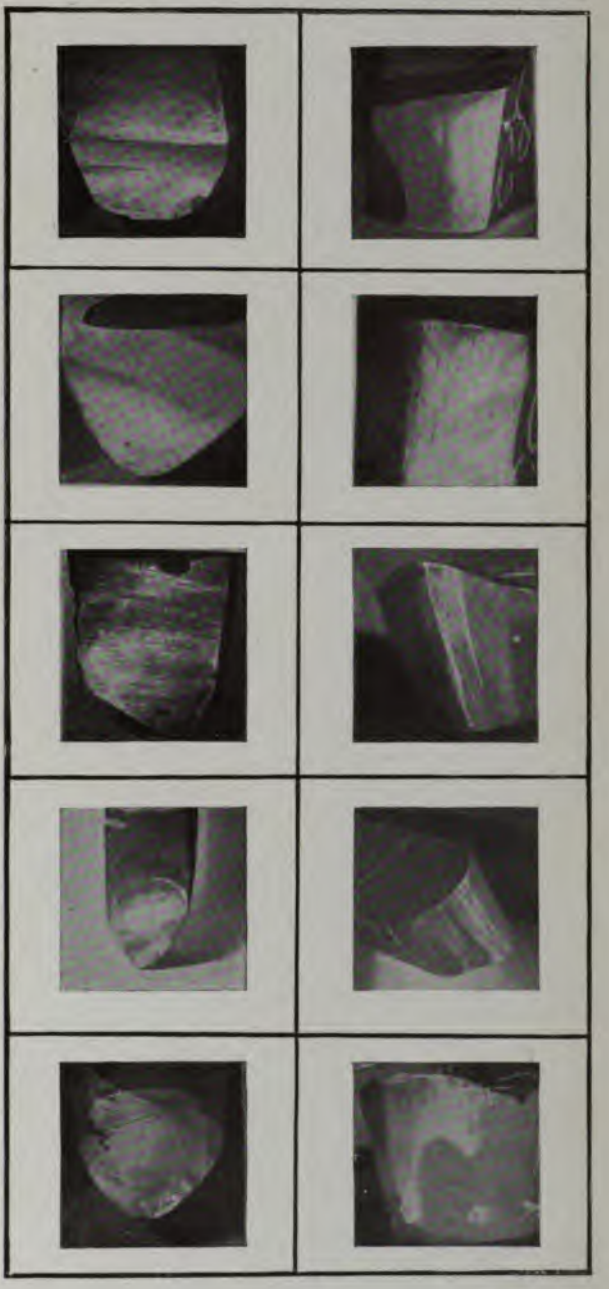

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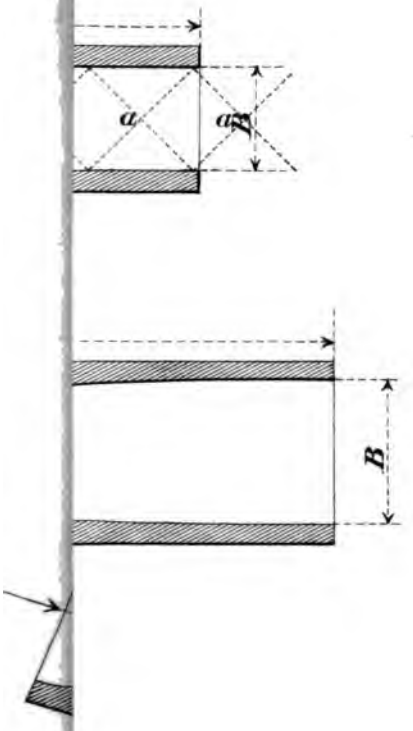
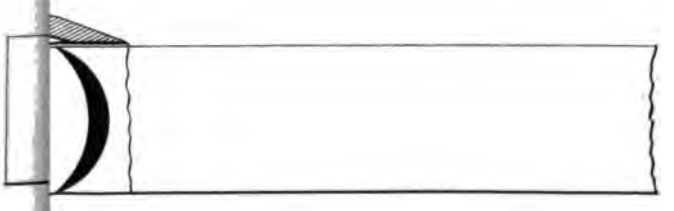



Fig. 3.



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Andw. Reid & Compy. Ltd. Newcastle on Tyne.

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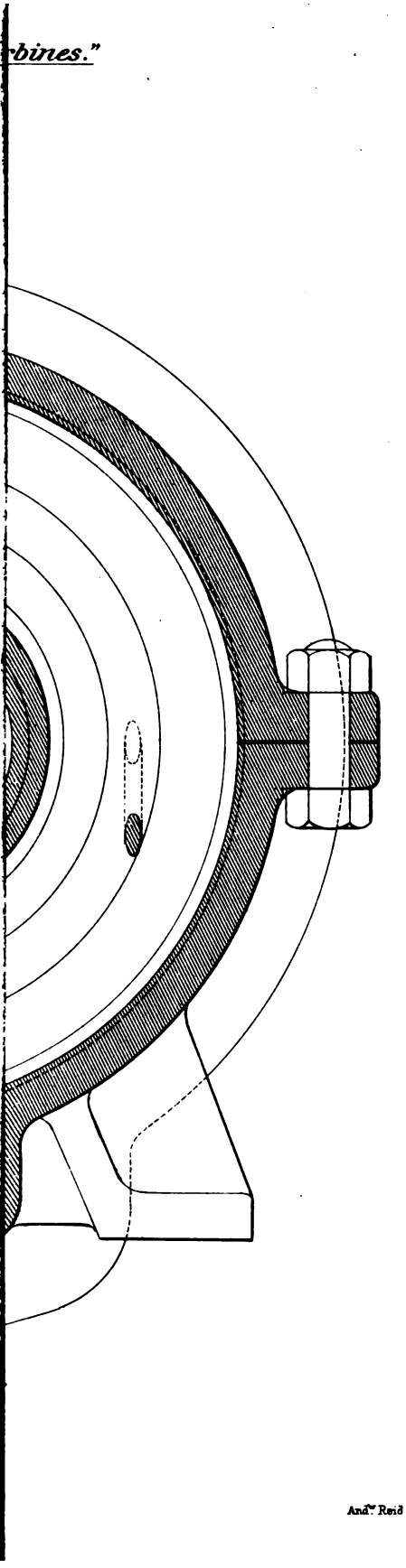
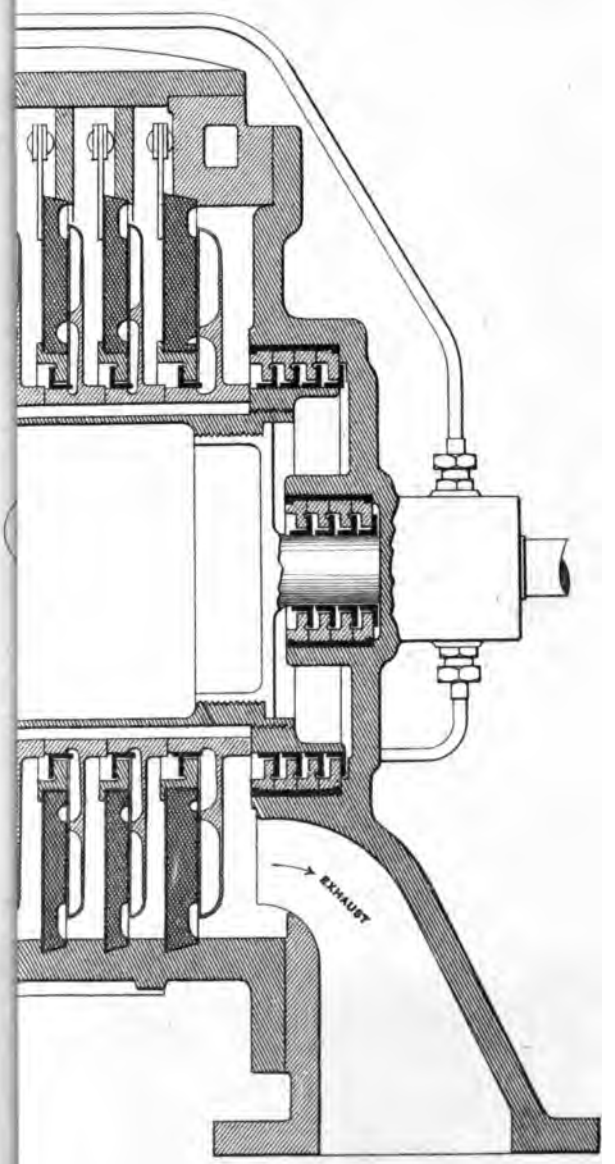


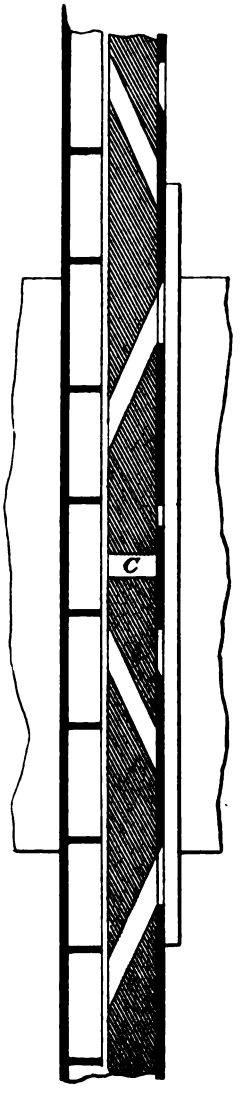


And.w Reid & Comp.y L.td Newcastle on Tyne






And.w Reid & Comp.y L.td Newcastle on Tyne.

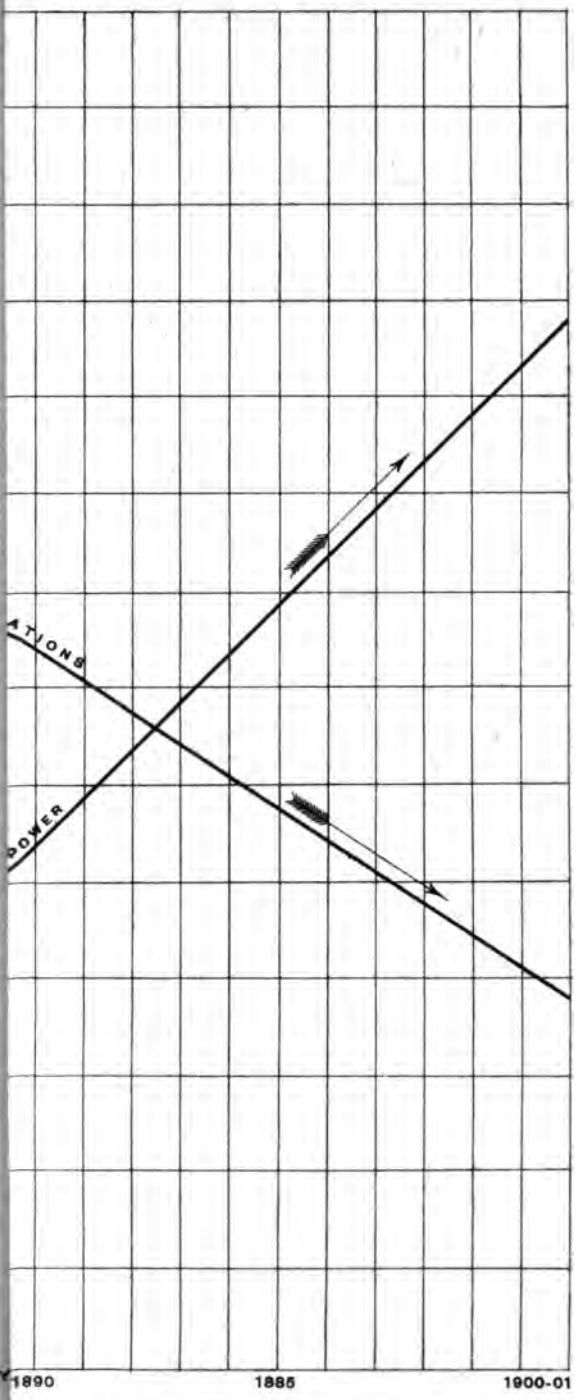



DEVELOPED SECTION.

And.r Reid & Comp.y L.d Newcastle on tyne

Engineer."

DIAGRAM 2.



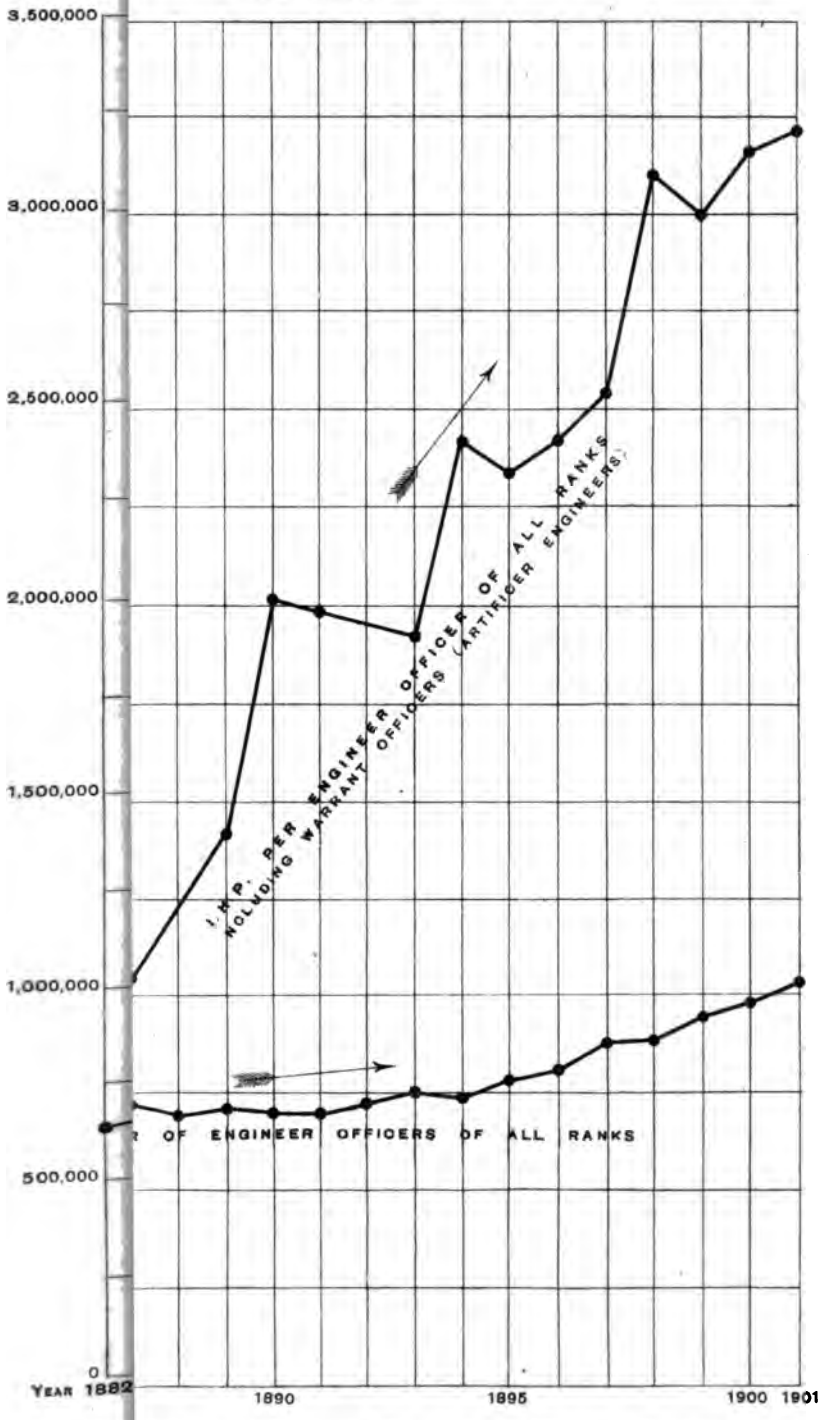

N Increase in I.H.P. in H.M. Navy and
Applications per Vacancy at the
Engineers' College, Keyham,
1882 to 1901 inclusive.



And^w Reid & Comp^y L^td Newcastle on Tyne

Engineer."

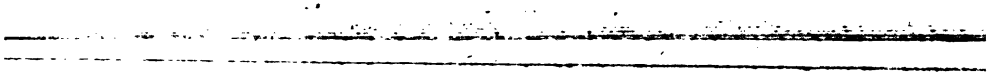
DIAGRAM 4.



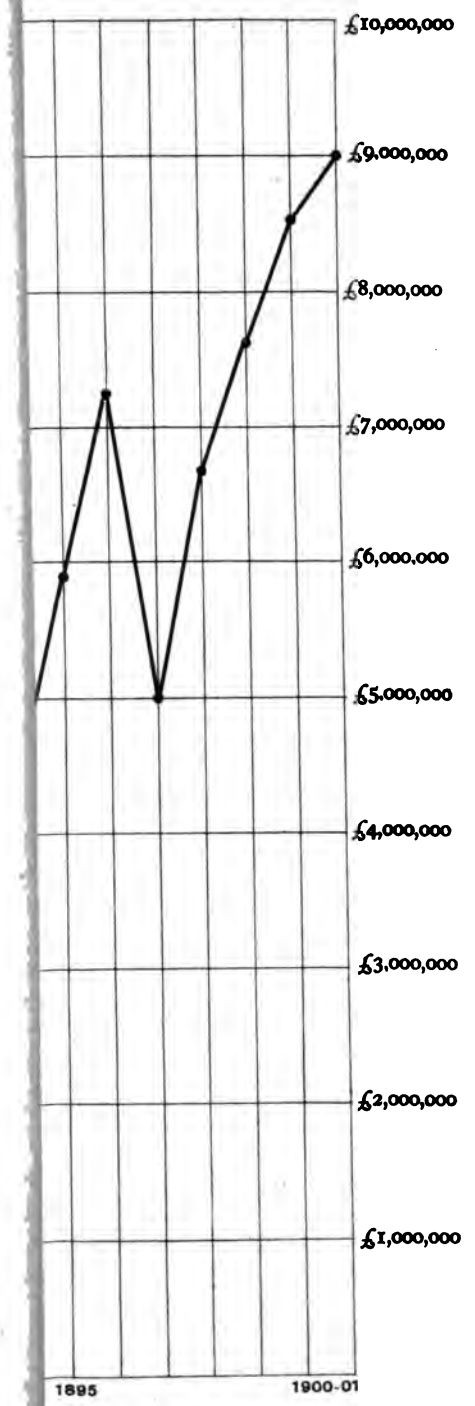

NUMBER OF ENGINEER OFFICERS AND WARRANT OFFICERS
ENGINEERS) IN H.M. NAVY AND I.H.P. PER OFFICER
FROM 1887 TO JUNE 30TH, 1901, INCLUSIVE.

Proceed

And^w Reid & Comp^y L^td Newcastle on Tyne



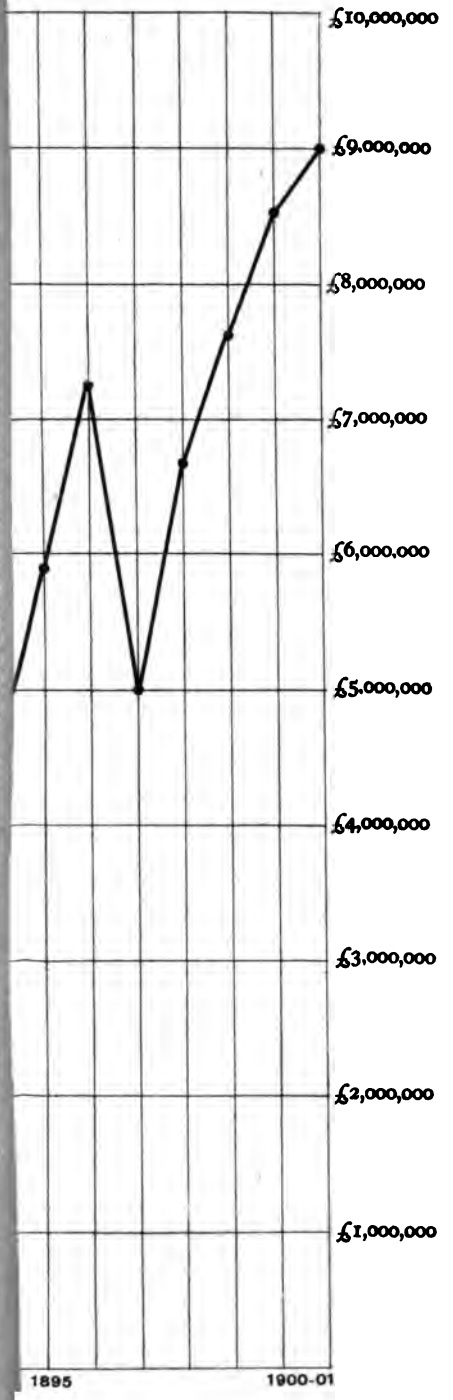
*ineer."*




FOR H.M. NAVY

Prod

And.w Reid & Comp.y L.td Newcastle on Tyne




FOR H.M. NAVY

Andw Reid & Compy Ltd Newcastle on Tyne

*To illustrate Mr. D. B. Morison's Paper on "The Naval Engineer."*

## DIAGRAM 6.

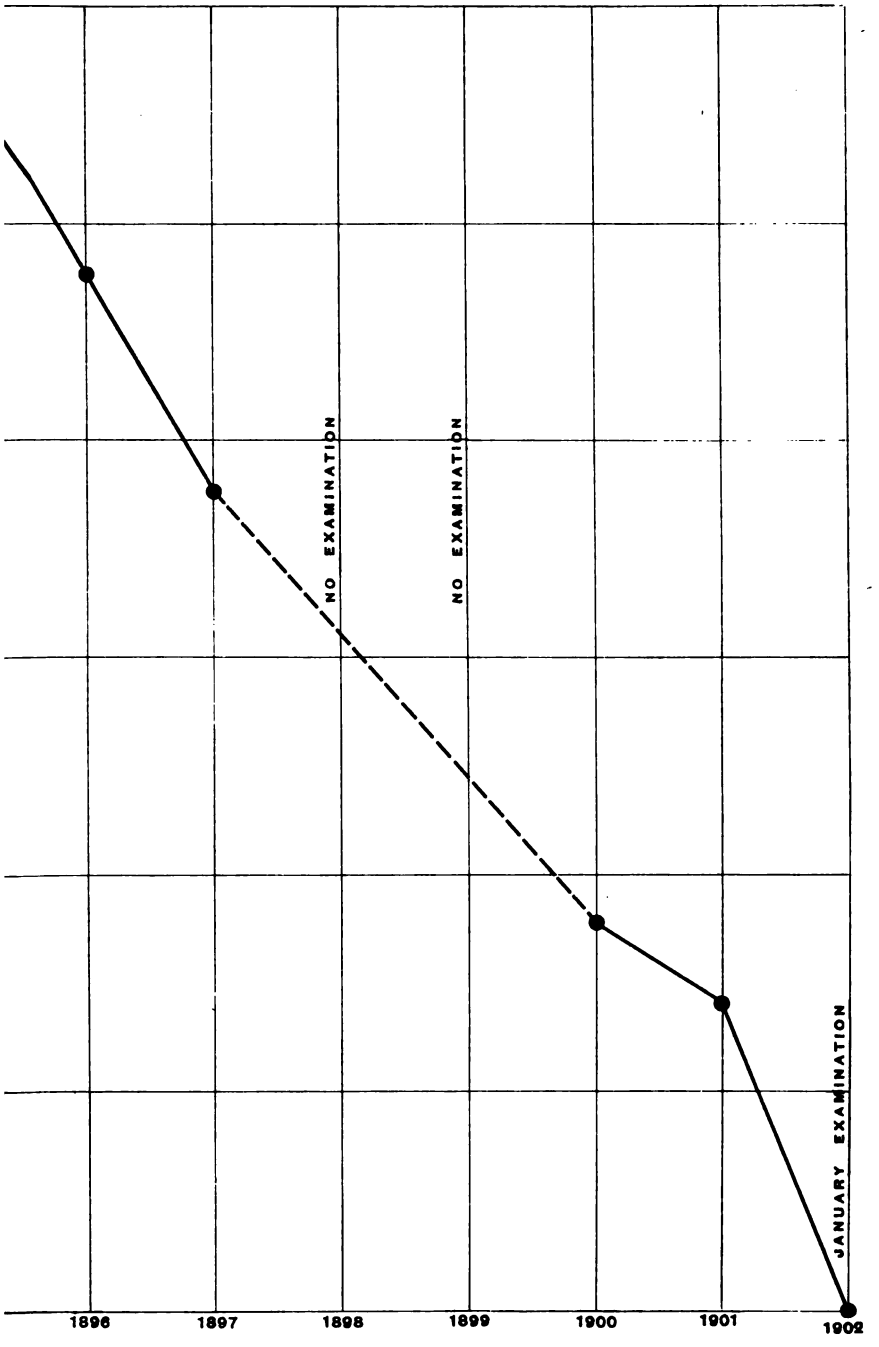
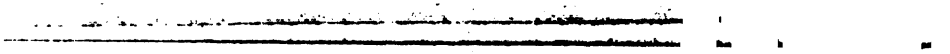



DIAGRAM SHOWING DECLINE IN CANDIDATES FOR "TEMPORARY SERVICE" ASSISTANT ENGINEERS IN H.M. NAVY, FROM 1895 TO JANUARY, 1902 INCLUSIVE.



And^w. Reid & Comp^y. L^td. Newcastle on Tyne.



*To illustrate Mr. M.C. James' Paper on "Passenger Accommodation in Steam-ships."*



FIG. 1.

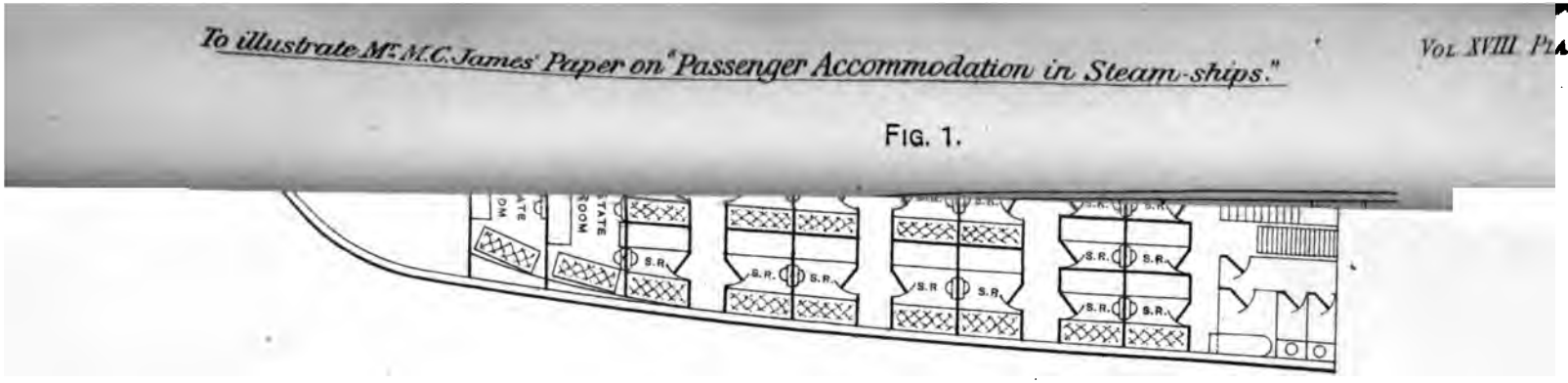
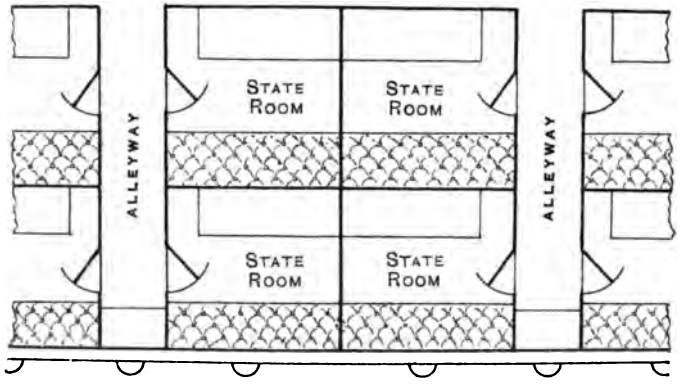



FIG. 3.




*Proceedings N.E.C.I. of E. & S. 1901-2*
*Session XVIII.*

And.w Reid & Comp.y Ltd. Newcastle on Tyne.

To illustrate Mr. M.C. James' Paper on "Passenger Accommodation in Steam-ships."



FIG. 1.

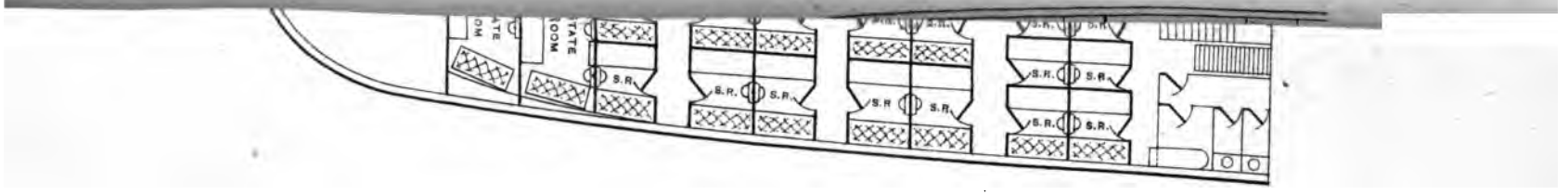
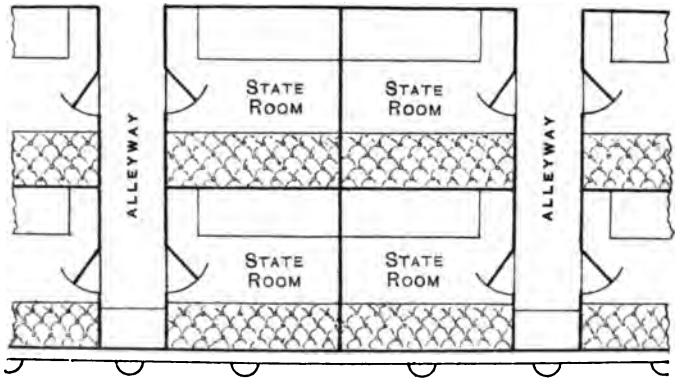



FIG. 3.

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Session XVIII.

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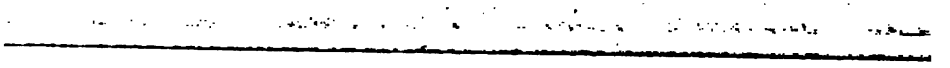

# TANDEM STATE ROOMS (BIBBY'S PATENT).

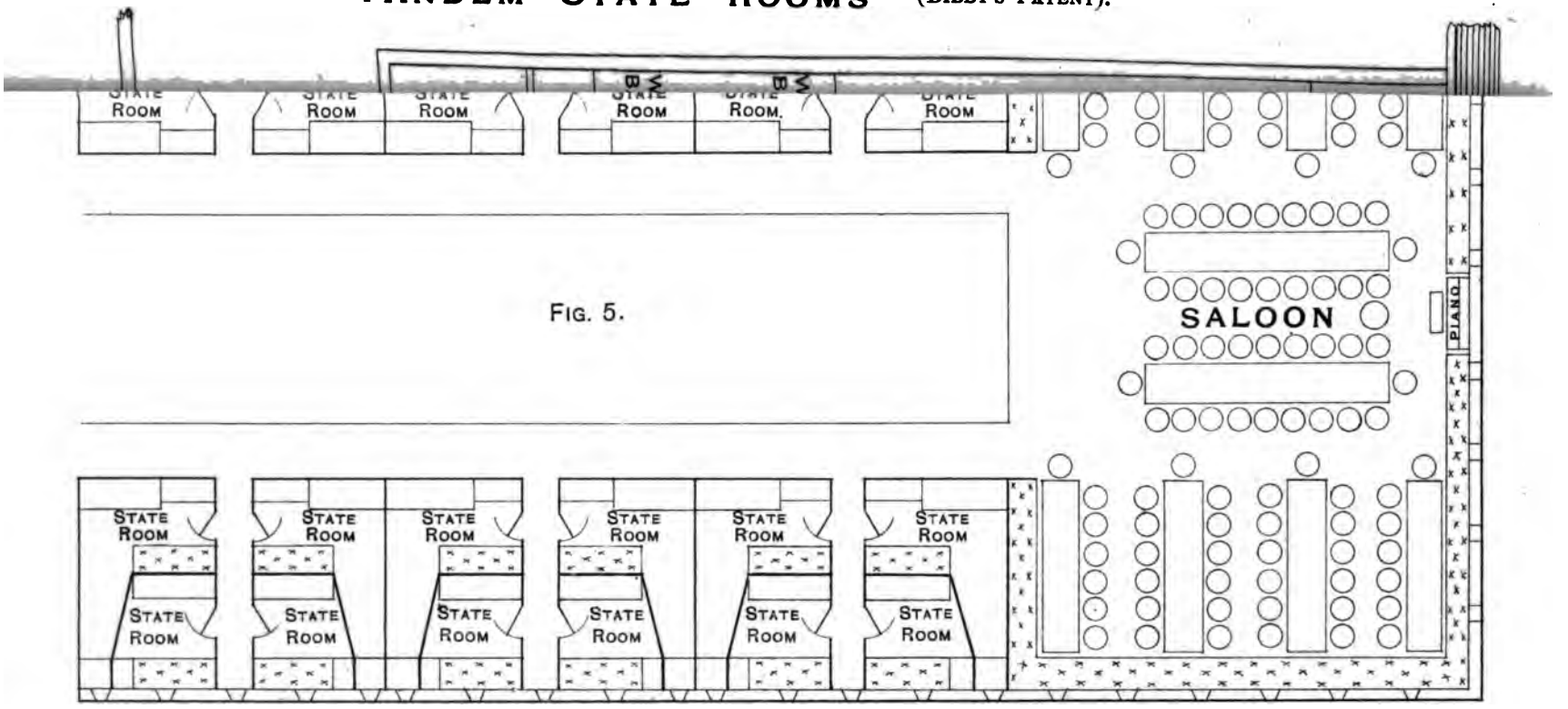


FIG. 5.

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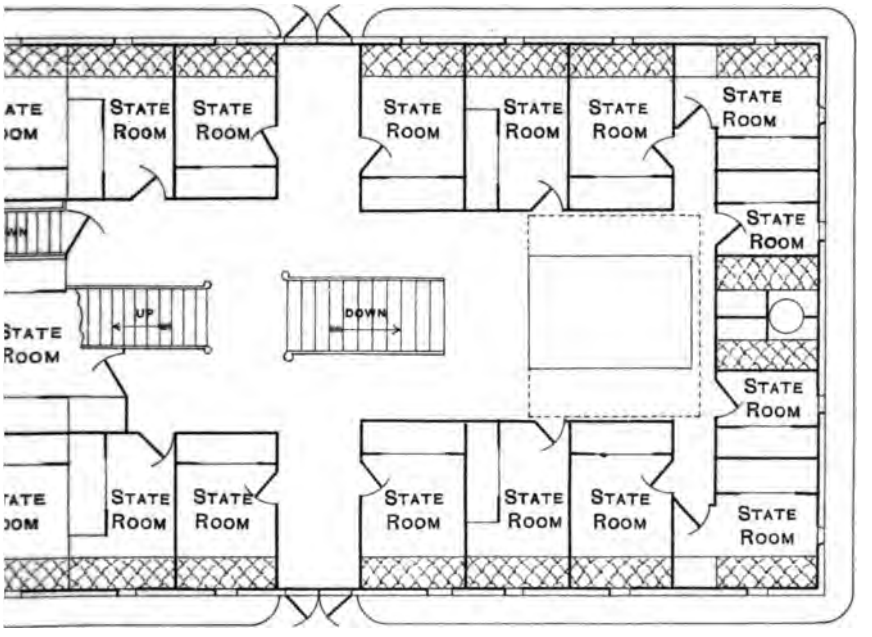
**ARRANGEMENT AS APPLIED TO STEAMERS NOW BUILDING.**

And.w Reid & Compy L.td Newcastle on Tyne.

*Illustrate M.r M. C. James' Paper on*
*"Passenger Accommodation in Steam-ships."*

## DECK CABINS.




## STATE ROOMS ON PROMENADE DECK.

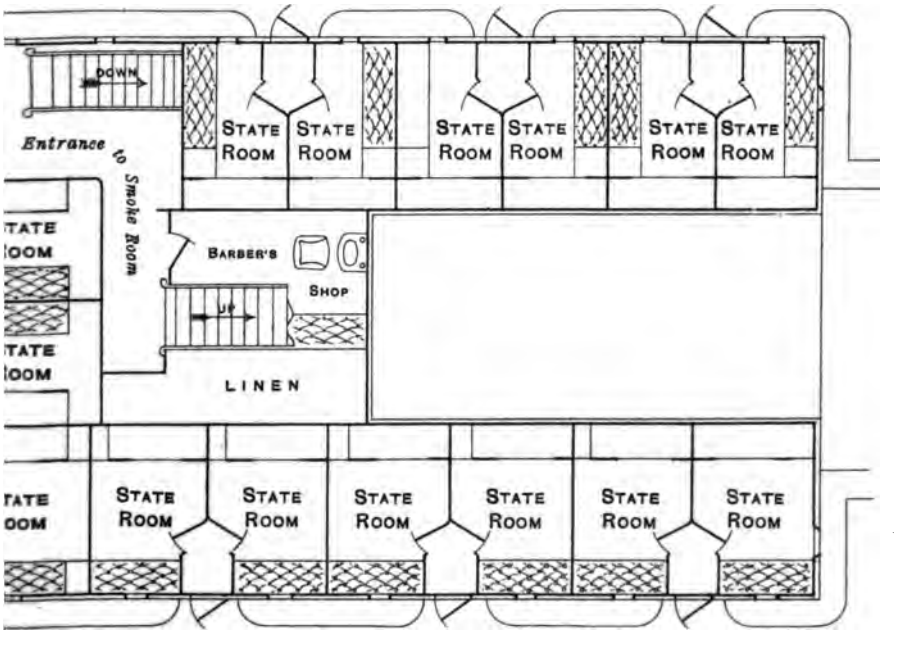



FIG. 6.



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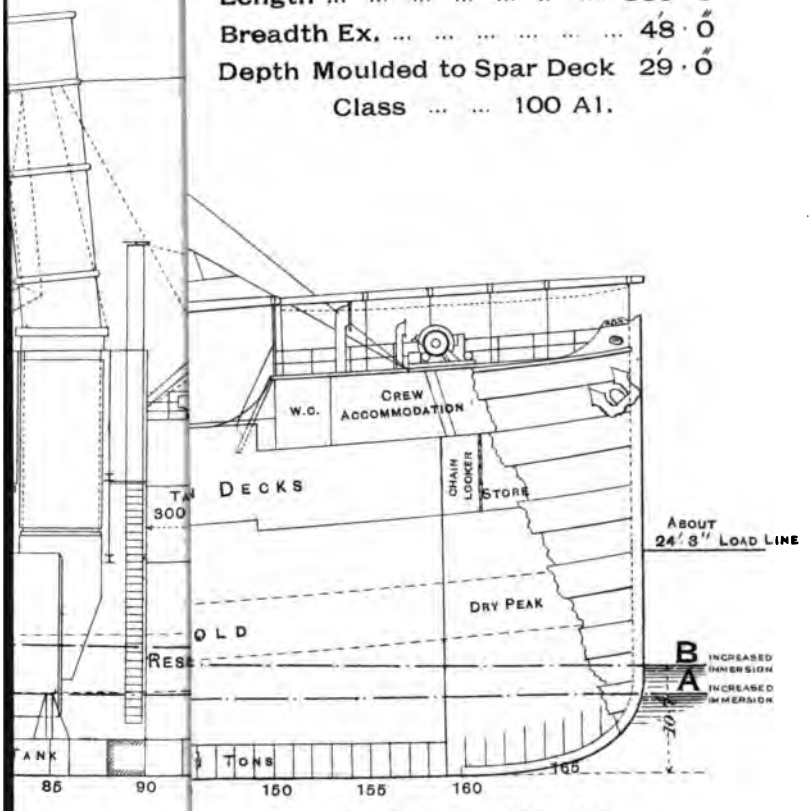
eply to the

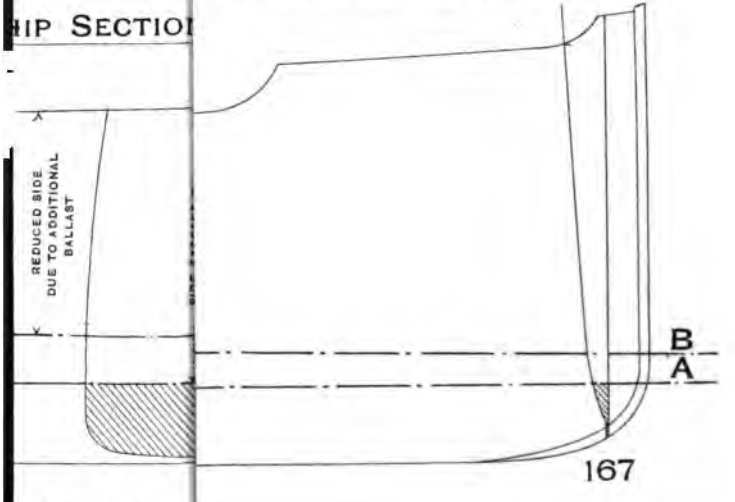
TANKS

Length ... ... ... ... ... ... ... 339·0″
Breadth Ex. ... ... ... ... ... ... 48·0″
Depth Moulded to Spar Deck 29·0″
Class ... ... 100 A1.



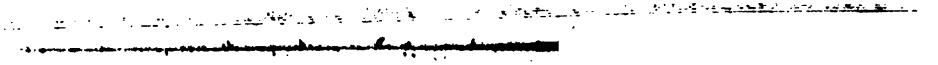

MIDSHIP SECTION
THROUGH FRAME No. 167

HIP SECTIO



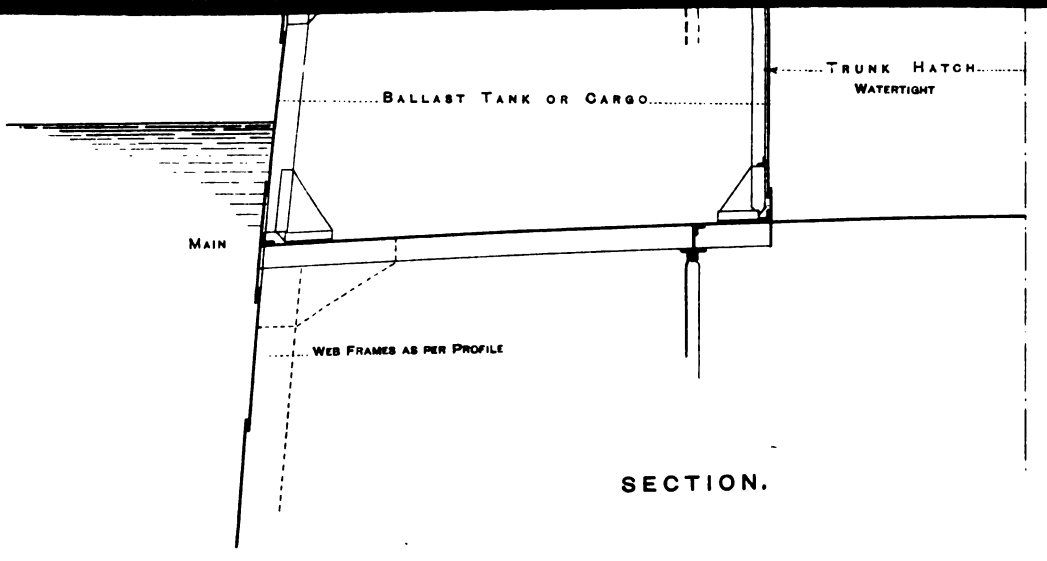

NS FOR

And.w Reid & Compy L.td Newcastle on Tyne



*To illustrate Mr E.C. Chaston's Reply to the "Discussion on his Paper."*

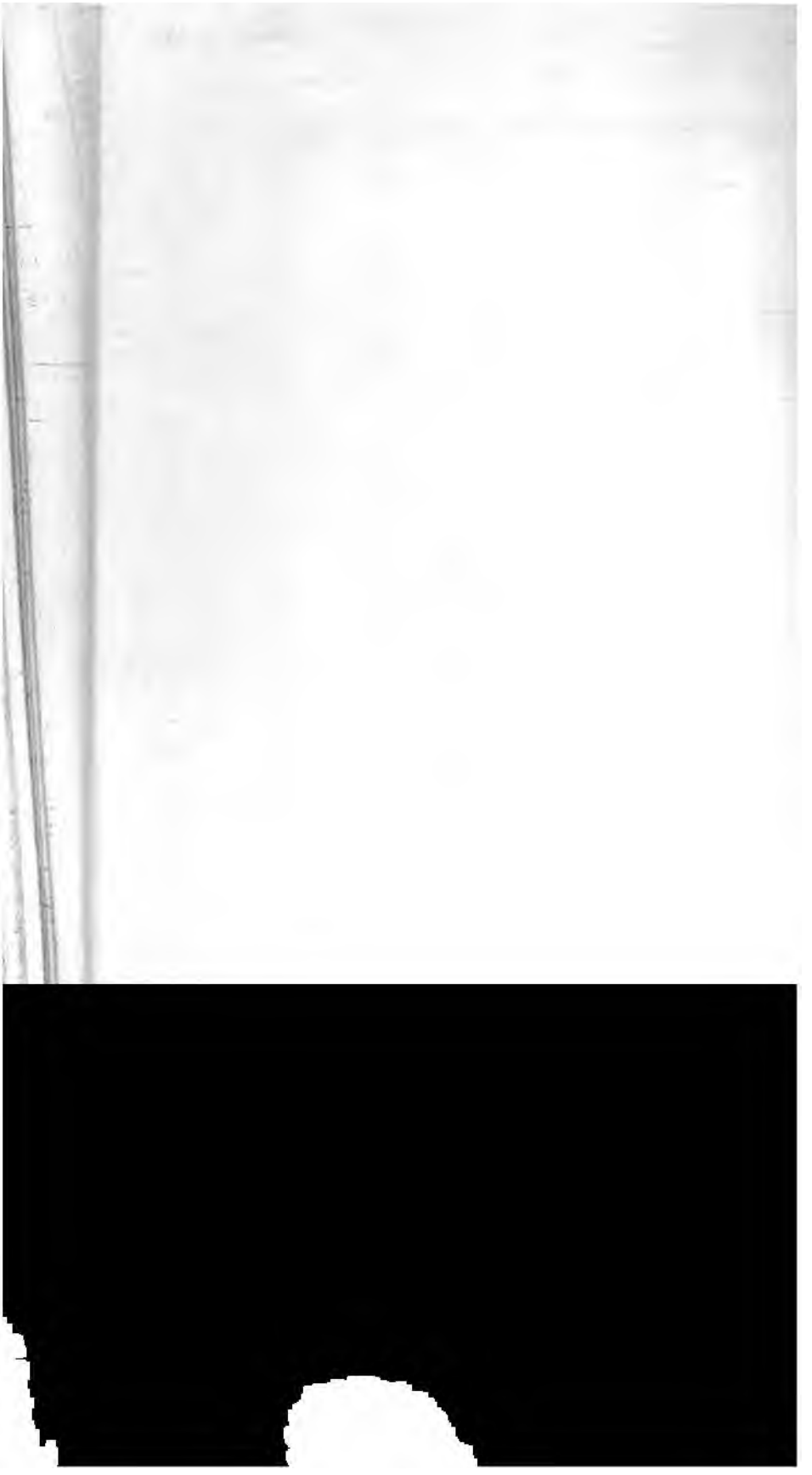
# SKETCH SHEWING 'TWEEN DECK BALLAST TANKS.




SECTION.

*Proceedings N.E.C.I. of E. & S. 1901-2*
*Session XVIII*

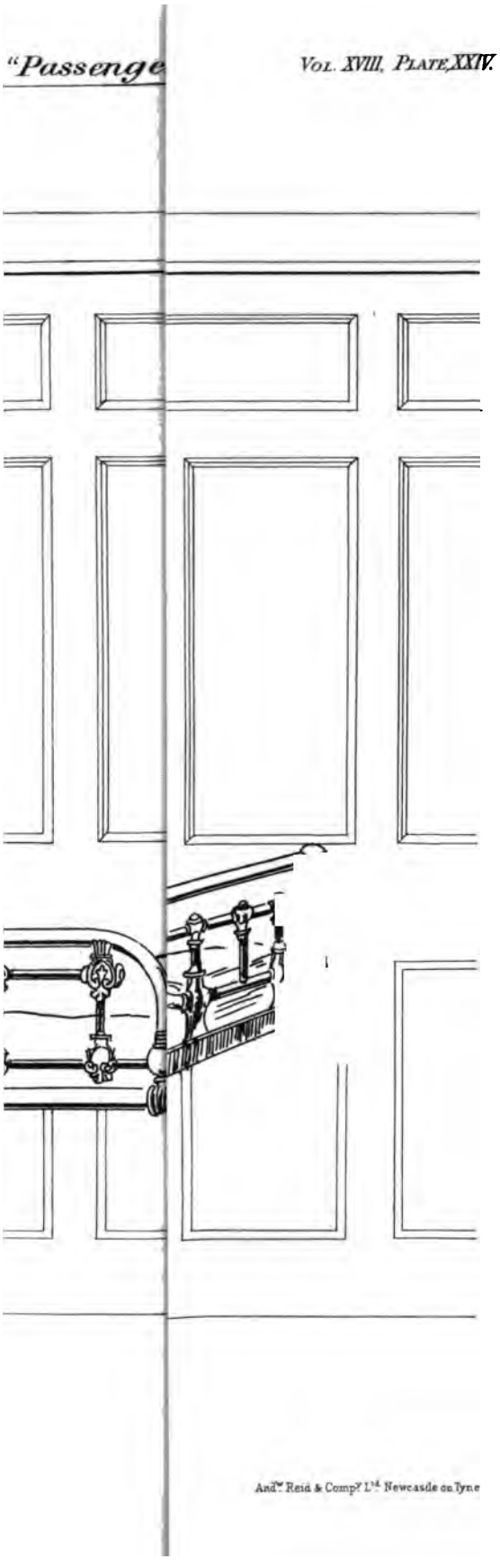
And^w Reid & Comp^y L^d wcastle on Tyne.



## PLAN OF SUITE OF ONE AND TWO-BERTH STATE ROOMS.

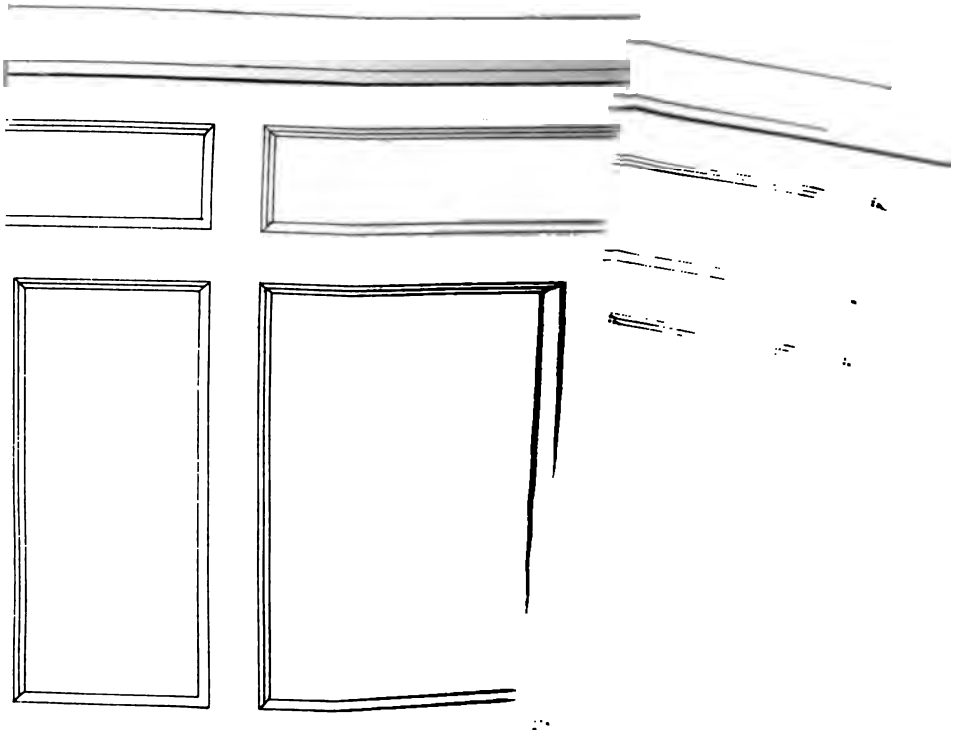
G. 1.

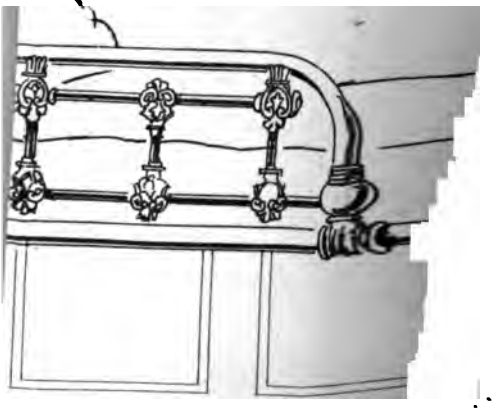
And.w Reid & Comp.y L.td Newcastle on Tyne



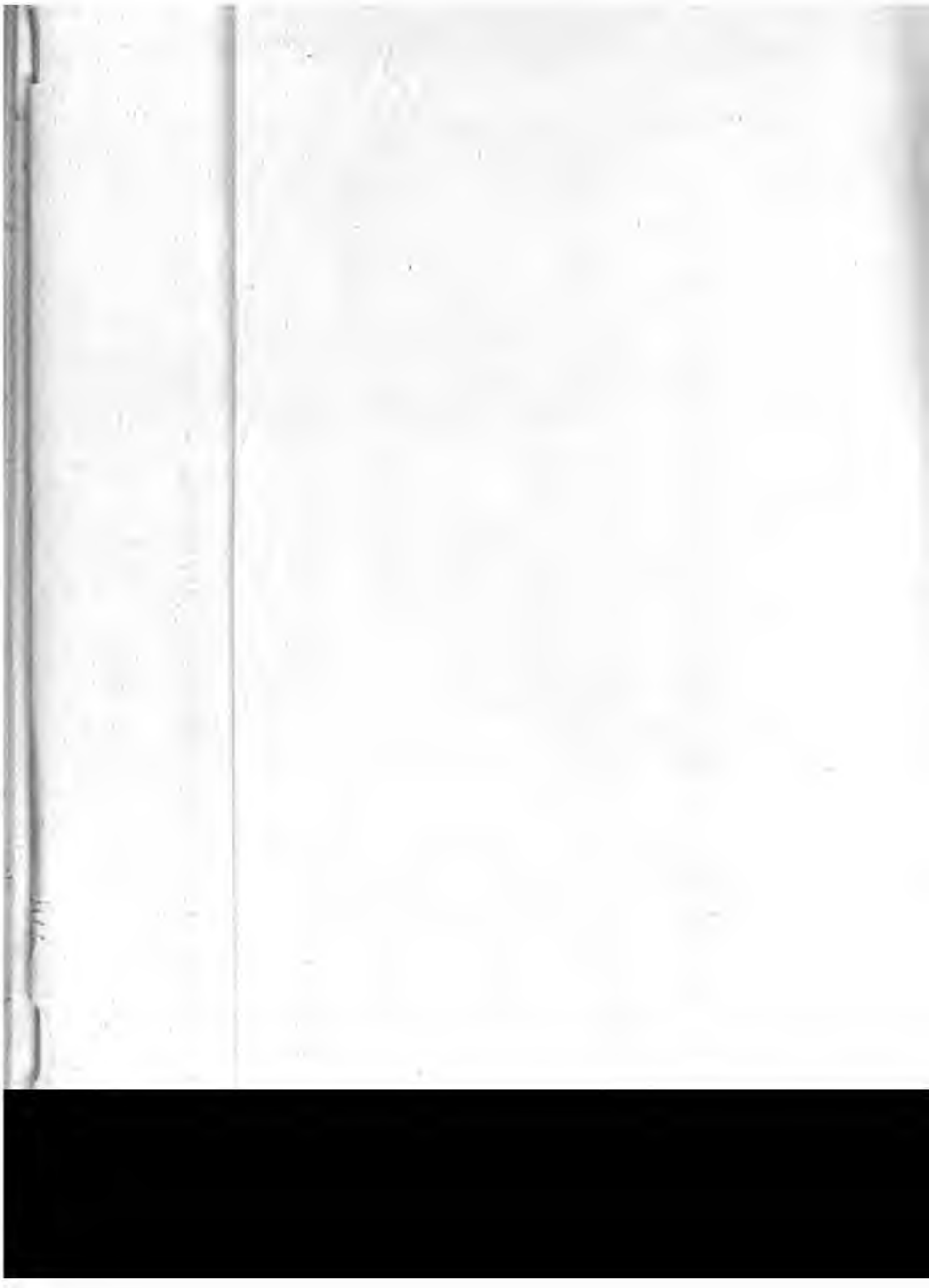
And.w Reid & Comp.y L.td. Newcastle on Tyne

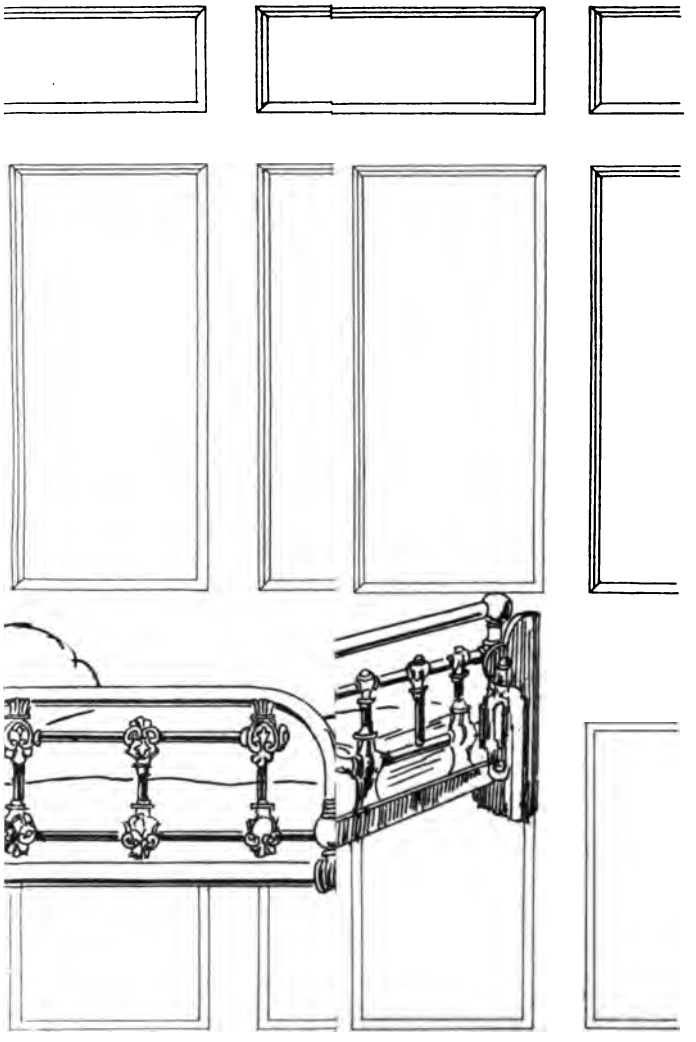
Paper on "Passenger Accommo



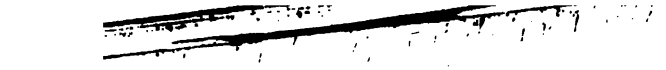


And.r Reid & Comp.y Lith. Newc





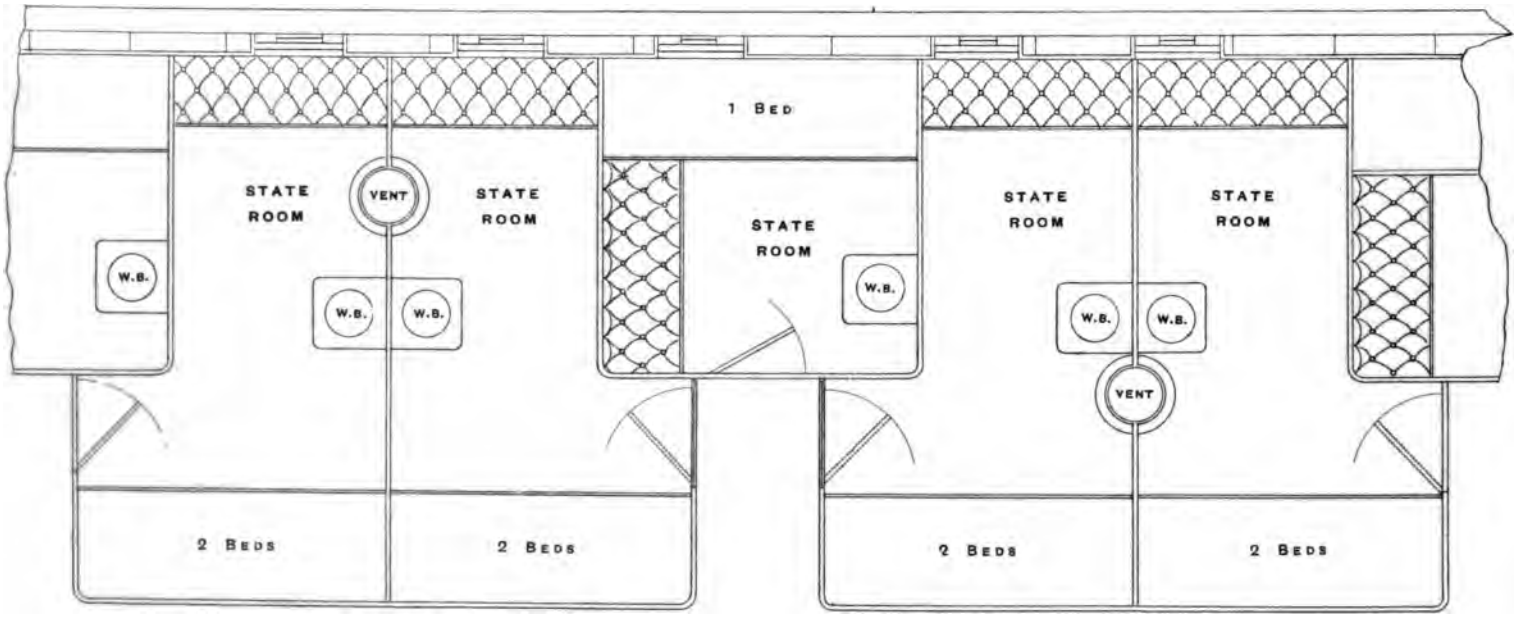
And.w Reid & Compy L.td Newcastle on Tyne.



*To illustrate Mr. W. L. Hall's Remarks on Mr. M.*

*To illustrate Mr. W. L. Hall's Remarks on Mr. M. C. James's Paper on "Passenger Accommodation."*

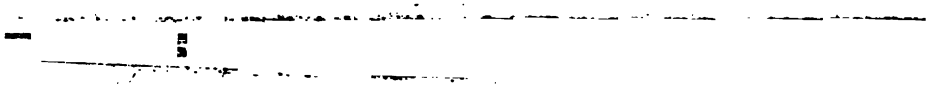
*To illustrate Mr. W. L. Hall's Remarks on Mr. M. C. James's Paper on "Passenger Accommodation."*

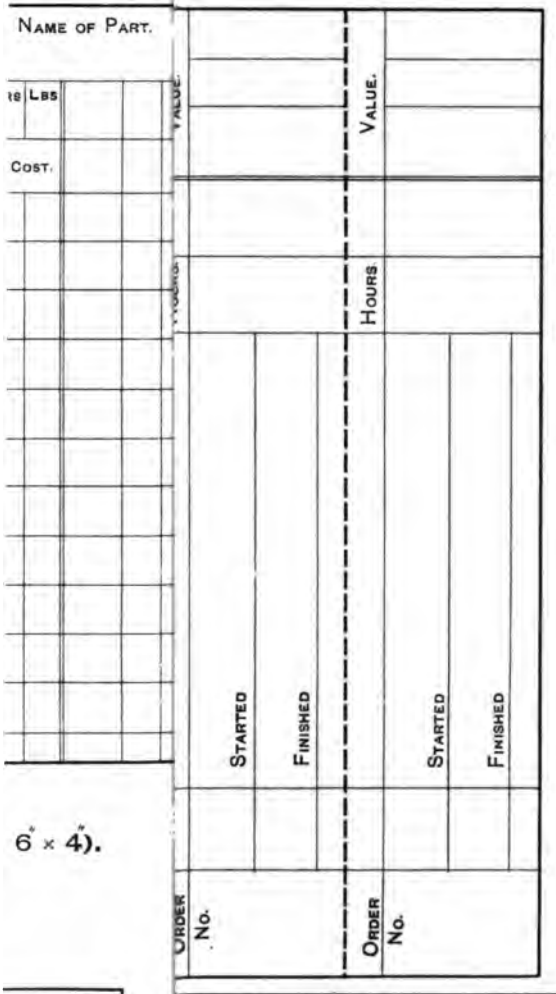



PLAN OF FIRST-CLASS CABINS **S.S. "DUNERA" AND "DILWARA."**

Pings N E C I of E & S 1901-2
Session XVIII

Andw Reid & Compy Ltd Newcastle on Tyne.





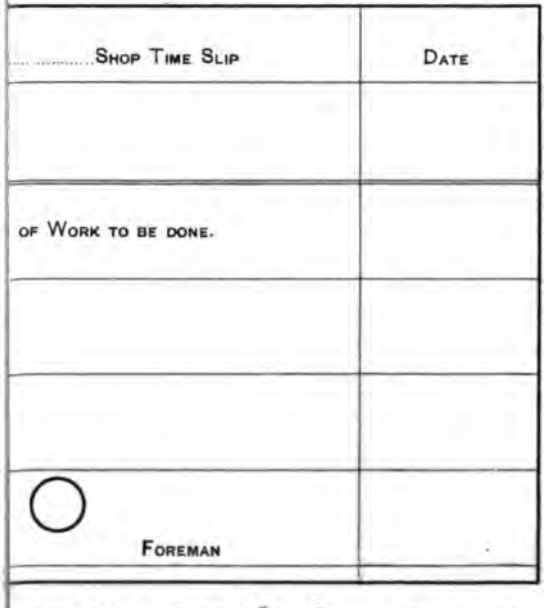

No. 5 Coupon Card. (Size, 8″ × 5″).

6″ × 4″).

o. 50

*'clock*

*man.*




Card (2). (Size, 5″ × 3″).

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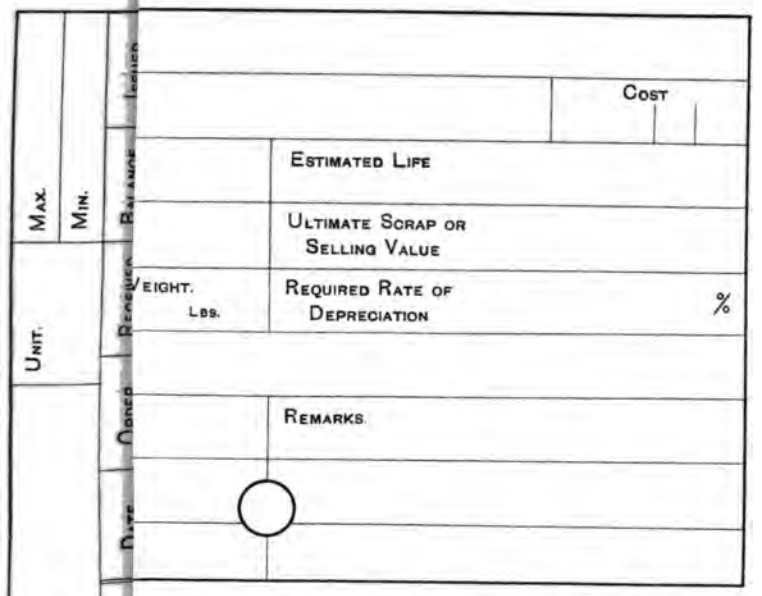
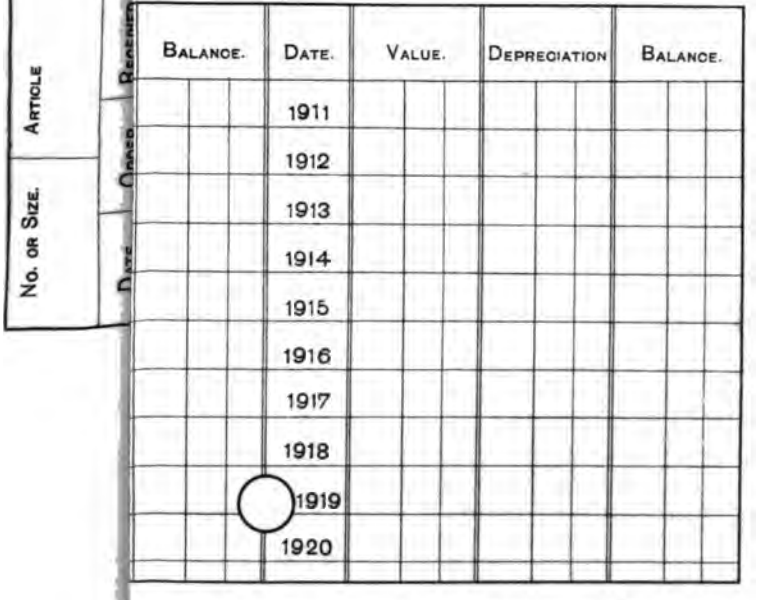


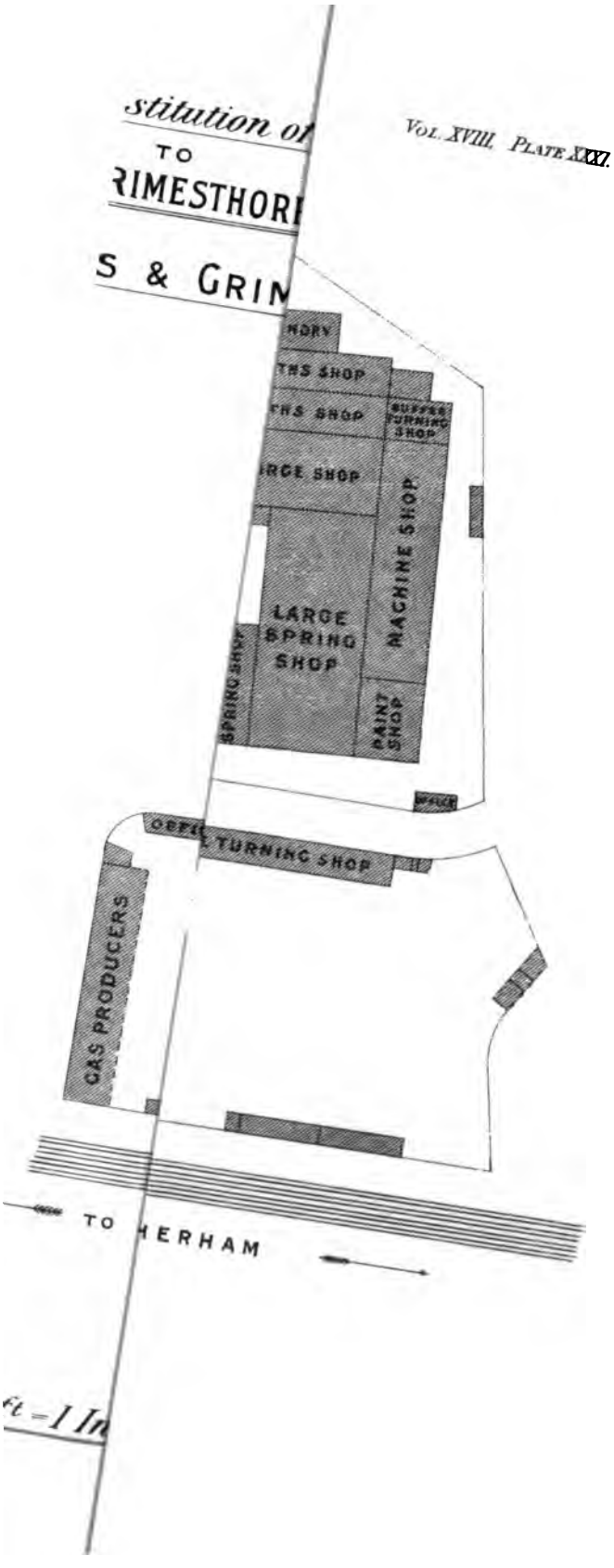

…l Machine Card, FACE. (Size, 5″ × 3″).




…l Machine Card, BACK. (Size 5″ × 3″).



And.ᵂ Reid & Compʸ L.ᵗᵈ Newcastle on Tyne


stitution of
TO
RIMESTHORE
S & GRIN
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TNS SHOP
SUPPER TURNING SHOP
RGE SHOP
MACHINE SHOP
LARGE SPRING SHOP
SPRING SHOP
PAINT SHOP
TURNING SHOP
GAS PRODUCERS
TO HERHAM
ft = 1 In